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**AMERICA'S ACCESS TO SPACE:
ASSURING FUTURE AFFORDABILITY**

by

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AMERICA'S ACCESS TO SPACE: ASSURING FUTURE AFFORDABILITY

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ABSTRACT

This thesis evaluates the U.S. government policies that mandate the DoD launch government payloads only from vehicles produced domestically as a means to protect America's national security interests. Unfortunately, over the past decade, the commercial space launch industry has suffered several programmatic and economic setbacks, culminating in the DoD being forced to financially maintain the commercial space launch industry. The result is a quasi-government-run program, plagued by overruns and consuming a preponderance of the DoD's appropriated space-systems budget.

How can the DoD afford to continue with its current strategy, given the realities within the industry? The evaluation of this question requires a better understanding of three issues: challenges within the domestic space launch industry; an analysis of domestic and foreign launch systems; and a review of outside contributing factors. It is apparent that the DoD's efforts to subsidize the industry are viewed as being essential, based on current policies. However, this strategy may, in fact, be weakening the U.S. space launch industry and creating a single point of failure that could jeopardize the DoD's ability to access space.

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LIST OF ACRONYMS AND ABBREVIATIONS

AWACS	Airborne Warning and Control System
CSIS	Center for Strategic & International Studies
CSLA	Commercial Space Launch Act
DoD	Department of Defense
DoDD	Department of Defense Directive
EELV	Evolved Expendable Launch vehicle
ESA	European Space Agency
EU	European Union
FY	Fiscal Year
GAO	Government Accountability Office
HSPD	Homeland Security Presidential Directive
ITAR	International Traffic in Arms Regulations
JAXA	Japanese Aerospace Exploration Agency
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NSPD	National Security Presidential Directive
NSS	National Security Strategy
OSTP	Office of Science and Technology Policy
ULA	United Launch Alliance
WTO	World Trade Organization

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I. INTRODUCTION

A. MAJOR RESEARCH QUESTIONS

This thesis examines the United States government's policies and practices of only contracting with domestic corporations to meet the Department of Defense's (DoD) access to space requirements. A result of these policies is the prohibition of potential space launch service providers who may be able to meet the DoD's requirements in a manner that is timelier, more affordable, and just as reliable as their U.S. counterparts. However, these attributes to date have not overcome certain national security concerns about foreign corporations and states having access to potentially sensitive information. As such, the DoD must find a balance where it can reap the potential benefits inherent within international collaboration, while bolstering the nation's security.

The evaluation of this issue is broken down into three key areas, which provide the necessary information and tools to help answer the question posed in this thesis. First, the thesis begins by examining current U.S. space launch policies that are mandating the DoD's use of domestic space launch suppliers and establishes an understanding of exactly what the government is paying to achieve and maintain access to space. The next section will present an overview and comparison of the reliability, capability, and cost of foreign space launch systems in relation to their American EELV counterpart. The thesis concludes by examining other

contributing factors that, while not directly affecting the DoD's current strategy, play a critical role in the establishment of the access to space policies.

B. IMPORTANCE

The use of space and space-related technologies has become an integral cornerstone of our society. Any diminished capability would affect our ability to exploit space for commercial, civil, and military means. The DoD has come to rely on space-based technologies as a force multiplier, providing the capability for real-time communications, providing weather forecasts to units in the field, and collecting intelligence information vital to America's national security at home and abroad. A disruption or degradation in the DoD's ability to exploit space would ultimately affect how we go about defending our homeland. Furthermore, since the DoD does not appear to be relaxing its reliance on space and space-based assets, we need to ensure that we are using the most efficient and effective means of maintaining our access to space.

This task will be a departure from the way the in which the DoD has historically approached the U.S. space mission. The United States will have to rely more on international support, rather than on the traditional government-driven domestic aerospace industry, to access, control, and exploit space as a medium to meet the needs of our nation. President Barack Obama's speech to the nation, on April 15, 2010, made this fact crystal clear. The President pointed out that as a nation we cannot continue on the path we have traveled over the past fifty years if we are to succeed in

the future.¹ This new reality has since permeated down to the DoD; the U.S. assistant secretary of defense for global strategic affairs, Michael Nacht, discussed the critical need to evolve our DoD space policies to match a growing reliance on international cooperation. This will undoubtedly affect many of our national security policies concerning preserving and maintaining the DoD's access to space.²

C. PROBLEMS AND HYPOTHESIS

The basic question this thesis addresses is whether the DoD can afford to continue and maintain its current strategy for assuring its access to space. The problem arises in attempting to determine the true motivation behind the current strategy, and the concerns that are preventing the government from allowing the DoD to utilize foreign suppliers as part of its space launch strategy. This strategy can become more efficient if the DoD were to incorporate international cooperation as it seeks to maintain the department's access to space rather than rely solely on the services of one American corporation.

The quandary that this problem highlights is how the DoD should go about achieving the proper balance between a strong defense industrial base and a reasonable and realistic fiscal approach toward space launch. There are proponents, both in the government and academic fields, who argue that the answer to this dilemma lies in the continued

¹ Barack Obama, "Remarks by the President on Space Exploration in the 21st Century" (speech, John F. Kennedy Space Center, Merritt Island, FL, April 15, 2010).

support and funding of the space launch industry as it exists today.³ These supporters stress that it is vital to maintain and expand the "intellectual capital" and technological innovations that can be harvested by the DoD's continued support of the aerospace industry.⁴ However, a growing number of people believe that the answer lies not in maintaining the status quo, but rather in expanding the means by which we can achieve our goal of assured access to space through more collaboration and competition. This idea is not new or revolutionary. The National Aeronautics and Space Administration (NASA) has come to rely on international collaboration to achieve its mission, most recently with the construction and operation of the International Space Station. What will be new is the idea of making this the norm, not the exception, for the DoD.

It is the author's hypothesis that the DoD can in fact access space more efficiently with more international collaboration, while also addressing the concerns it has regarding protecting our national security.

D. LITERATURE REVIEW

The debate on whether to continue to use domestic space launch providers, rather than broaden the spectrum of potential suppliers, is one that has been ongoing for several years. However, there is a discrepancy in the logic

² Turner Brinton, "International Cooperation Emphasis of Forthcoming U.S. Space Policy," *Space News*, May 21, 2010.

³ Scott Pace, "Challenges to US Space Sustainability," *Space Policy* 25, no. 3 (August 2009), 158; Philip K. Lawrence, *Aerospace Strategic Trade: How the U.S. Subsidizes the Large Commercial Aircraft Industry* (Burlington, VT: Ashgate Publishing Limited, 2001), 86-112.

⁴ Pace, "Challenges to US Space Sustainability," 158.

regarding the need to maintain a domestic space launch capability, with the fact that it is already being subsidized and directed almost exclusively by the DoD. Many will argue that this position is shortsighted and even harmful to the domestic space launch industry.⁵ Such government policies and practices ignore the economic fact that consumers, including the DoD, should seek out and use suppliers who offers these services in the most effective manner and at the lowest price, whether from foreign or domestic space launch providers, as long as there are no security concerns with doing so.

This notion, however, is offset by the belief that the space launch industry is of vital national interest and, as such, it needs to be protected and preserved by the federal government. The Bush administration's 2006 U.S. National Space Policy clearly states that one of the goals of the administration, with regard to maintaining our access to space, was to "preserve its rights, capabilities, and freedom of action in space" and to "dissuade or deter others from impeding those rights."⁶ This policy has been criticized as promoting a "go it alone" strategy, while ignoring the value to be gained through international cooperation and partnership. Then, in June of 2010, the Obama administration issued a revised National Space Policy whose primary goals were to "energize competitive domestic

⁵ The United States Air Force is recognized as the lead agency for maintaining and launching the Department of Defense's space systems. As such, it has become the Department of Defense's space launch contracting authority as well; Executive Office of the President, National Science and Technology Council, *U.S. National Space Policy* (Washington, D.C.: Office of Science and Technology Policy, 2006), 1-2.

⁶ Executive Office of the President, *U.S. National Space Policy*, 1-2.

industries" and to "expand international cooperation."⁷ Yet, this policy sidesteps these goals when it comes to assured access to space, mandating that all government and DoD satellites shall be launched from domestic providers in an effort to enhance the nation's capabilities to access space.⁸ This inconsistency highlights the disjointed nature of the 2010 policy in trying to guide the use of space to meet the goals set forth in the document.

The issue, therefore, is whether the 2006 or 2010 U.S. Space Policies are relevant in today's environment. The National Space Forum in 2008 met to examine key policy decisions that need to be addressed by the new Obama administration. The forum focused on the stability of the U.S. civil space sector, considering all the budgetary and resource challenges facing the administration.⁹ One of the most pertinent issues examined was whether the current set of export control laws and regulations are doing America's national security and economic interests more harm than good. Specifically, the continued use of inefficient and outdated policies, such as the International Traffic in Arms Regulations (ITAR), not only hinders the DoD's effectiveness, but complicates military alliances as well.¹⁰ Ultimately, the level of regulation imposed must balance the

⁷ Executive Office of the President, *U.S. National Space Policy*, 4.

⁸ Executive Office of the President, *U.S. National Space Policy*, 5.

⁹ Eligar Sadeh, "Space Policy Challenges Facing the Barack Obama Administration," *Space Policy* 25, no. 2 (May 2009), 109-116.

¹⁰ Robert Gates, "Remarks by the Secretary of Defense on Export-Control Reform" (Speech, Business Executives for National Security, Washington, D.C., April 20, 2010).

goals of protecting America's national security with maintaining a competitive market base from which the United States can benefit economically.¹¹

American policies and practices are consistent in their message: We must protect the American defense industrial base if the United States is to remain a relevant space power. Unfortunately, policymakers continue to struggle with how to develop an efficient and effective set of policies to accomplish that aim, while also protecting this key component of our national security and homeland defense. Therein lies the gap between how the DoD is meeting its access to space requirements and what truly is best for the nation. The confusion from policy to practice is understandable; the guiding space policy effectually creates this confusion. While the U.S. National Space Policy presents a firm and authoritative perspective on how the United States plans to execute its national policy, it also offers a contradictory view as to how we should go about achieving that goal. Specifically, the policy directs the Secretary of Defense to provide "reliable, affordable, and timely access to space," and endeavor to use cost-effective U.S. commercial firms, but also allows the use of foreign commercial services if available and required.¹² The most perplexing contradiction lies in the guidance regarding international space cooperation. With the cited goal of enhancing international cooperation, the government should "augment U.S. capabilities by leveraging existing and planned space capabilities of allies and space partners,"

¹¹ Gates, "Remarks by the Secretary of Defense," 111-112.

¹² Executive Office of the President, *U.S. National Space Policy*, 2010, 14.

but then prohibiting foreign systems to be used as part of the DoD's assured access to space strategy.¹³

Scott Pace, the current director of George Washington University's Space Policy Institute, argues that the United States should not restrict the DoD to using only the American aerospace giants to meet its space launch requirements. Believing that the space launch industry is, in fact, facing an "underlying erosion of the space industrial base which has further exacerbated the problems of cost growth and weak innovation," leading many to believe that the United States should seek to use more commercial and international capabilities to meet our nation's growing requirements.¹⁴ The Institute for Foreign Policy Analysis noted in its 2009 Space and U.S. Security Assessment that one of the largest gaps in U.S. space capabilities lies in the basic ability to deliver effective and cost-efficient systems, as compared to other international countries and their domestic corporations and/or consortiums.¹⁵ This difference leads one to assume that the driving force behind the market-share differential within the commercial launch industry is the ability of foreign corporations to provide comparable space launch capabilities at a lower cost.

The debate over this issue is not restricted to academics and civilian institutions. Over the past few years, the Government Accountability Office (GAO) has issued

¹³ Executive Office of the President, *U.S. National Space Policy*, 2010, 7.

¹⁴ Pace, "Challenges to US Space Sustainability," 156-159.

¹⁵ Robert L. Pfaltzgraff Jr., *Space and U.S. Security: A Net Assessment* (Cambridge, MA: The Institute for Foreign Policy Analysis, Inc., 2009), 13-16.

numerous studies regarding issues of the sustainability, affordability, and efficiency of America's space launch capabilities.¹⁶ The GAO cited numerous uncertainties in the Evolved Expendable Launch Vehicle (EELV) program's ability to meet the program's cost, schedule, and technical milestones.¹⁷ Specifically, the Air Force's use of program cost estimates, which explicitly assumed a robust commercial market would offset the government's cost burden, was an inaccurate assumption.¹⁸ Regrettably, the DoD is unable to quantify exactly how large this burden will become. This trend will continue to rise, due in large part to the diminishing commercial satellite market and the cancellation

¹⁶ Christina Chaplain, *Space Acquisitions: Government and Industry Partners Face Substantial Challenges in Developing New DOD Space Systems* (Washington, D.C.: Government Accountability Office, 2009); Cristina Chaplain et al., *Space Acquisitions: DOD is Making Progress to Rapidly Deliver Low Cost Space Capabilities, but Challenges Remain* (Washington, D.C.: Government Accountability Office, 2008); Government Accountability Office, *Space Acquisitions: Uncertainties in the Evolved Expendable Launch Vehicle Program Pose Management and Oversight Challenges* (Washington, D.C.: Government Accountability Office, 2008); Government Accountability Office, *Space Acquisitions: DoD Needs a Department wide Strategy for Pursuing Low-Cost, Responsive Tactical Space Capabilities* (Washington, D.C.: Government Accountability Office, 2006).

¹⁷ The Department of Defense and U.S. Air Force launched the Evolved Expendable Launch Vehicle program in 1995 as America's next generation of space launch vehicles, hoping to capitalize on an efficient and new generation of vehicles developed by Lockheed Martin and the Boeing Corporation (Government Accountability Office 2008, *Space Acquisitions: Uncertainties in the Evolved Expendable Launch Vehicle Program Pose Management and Oversight Challenges*, 4).

¹⁸ Government Accountability Office, *Space Acquisitions: Uncertainties in the Evolved Expendable Launch Vehicle Program Pose Management and Oversight Challenges*, 1-4.

of NASA's Constellation program, which are driving up the sustainment and procurement costs levied upon the DoD.¹⁹

Unfortunately, the Department of Defense and Air Force acquisition policies and program offices are also inefficient and undermanned, decreasing the likelihood that the sweeping reforms required to meet the DoD's EELV forecasts can ever be achieved.²⁰ Many proponents have speculated that the most cost efficient and technically effective manner for the DoD to preserve its access to space is to begin planning to supplement the once purely government-backed launch programs with contributions from international partnerships, much in the same manner as its civil counterpart NASA has done with the International Space Station.²¹

E. METHOD AND OVERVIEW

The next chapter of the thesis takes an analytical approach to examine the current state of the DoD's assured access to space program. It examines the policies and regulations guiding the actions of the DoD, as well as presents an overview of the challenges inherent within the strategy and program that are giving rise to uncontrollable

¹⁹ Henry R. Hertzfeld and Nicolas Peter, "Developing New Launch Vehicle Technology: The Case for Multi-National Private Sector Cooperation," *Space Policy* 23, no. 2 (May 2007), 81; Doug Messier, "Air Force Wrestles with EELV Launch Costs as NASA Weighs Options," *Parabolic Arc*, April 1, 2010; Todd Harrison, *Looking Ahead to the FY 2011 Defense Budget: A Review of the Past Decade and Implications for the Future Year Defense Program* (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2010), 15-17.

²⁰ Chaplain, *Space Acquisitions: Government and Industry Partners Face Substantial Challenges in Developing New DOD Space Systems*, 16.

²¹ Henry R. Hertzfeld and Nicolas Peter, "Developing New Launch Vehicle Technology: The Case for Multi-National Private Sector Cooperation," 81-89.

costs. Chapter III presents an analysis of the alternate means by which the DoD could fulfill its access to space requirements. It presents an overview of the current Evolved Expendable Launch Vehicle (EELV) program alongside three other comparable launch systems, focusing on the reliability, capability, and costs of each system. This analysis helps in creating an effectiveness comparison between each system, highlighting any technical or programmatic reasons that may be restricting the DoD from using a foreign service provider. Chapter IV presents an assessment of other factors that may be influencing the government's decision to mandate the DoD's use of domestic space launch providers. In addition, Chapter IV will evaluate of the potential effects that the current export control regulations may have on the program, as well as any protectionist policies that may be influencing the government's policies.

The final chapter presents the conclusions and recommendations developed based on the research conducted. The initial conclusions of this thesis suggest that the decision to use American-based space launch suppliers exclusively, rather than adopt a more diverse strategy, is creating more harm than good for the DoD. This strategy appears to be weakening the defense industrial base by creating an environment of overreliance on government subsidies, rather than focusing on innovation through competition in the free market to bolster the American space launch industry. This could translate into a degraded ability of the DoD to meet the needs of the nation in enhancing its national security and homeland defense.

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II. CHALLENGES WITHIN THE DOMESTIC SPACE LAUNCH MARKET

Since the Global War on Terrorism began in 2001, the U.S. Defense budget is increasing at rates not seen since the end of the Cold War, accounting for 4.3 percent of the nation's gross domestic product and surpassing more than \$335 billion spent since the turn of the century.²² However, the question of the day is not why we are spending so much, but rather, how long we can continue to support a defense budget that has increased 89 percent over the past decade?²³ The budget is guided by outdated policies that are forcing the DoD to enter into fiscally irresponsible decisions, with no apparent national security justifications.

To understand the goals and objectives of the DoD's strategy of meeting its access to space requirements requires an understanding of the primary factors influencing the strategy. Therefore, this chapter presents an evaluation of the current environment, in the hopes that it will help determine whether the DoD can afford to continue the current strategy into the future. First, an overview of key U.S. policies is presented to shed light into the guidance the DoD is receiving about how it must fulfill its requirements. The second part of this chapter examines the current strategy chosen by the DoD, highlighting the recent history and future trends within the domestic space launch

²² Anup Shah, "World Military Spending," *Stockholm International Peace Research Institute*, July 7, 2010.

²³ Shah, "World Military Spending."

industry. The final section of this chapter examines the current state of the EELV program, stressing the challenges the DoD faces in meeting the fundamental tenets of achieving the United States' goal of affordable, assured access to space in the future.

A. U.S. POLICY OVERVIEW

The Department of Defense's decision as to which space launch provider it selects to meet its mission needs is not a decision that is solely up to the department's leadership. This decision is ultimately guided and influenced by the policies issued, not only from within the DoD, but from the Office of the President, the Department of Homeland Security, and a host of other agencies, as well as directives that are codified in public law. These policies should seek to maximize the efficient use of taxpayer dollars to obtain America's national security objectives. However, space systems have become the fastest-growing DoD procurement area over the past ten years, increasing at a real annual rate of 16.2 percent per year. It is also quadrupling the space system's procurement budget, of which maintaining the space launch capability represents 39 percent.²⁴ The predicament remains, does the current practice of using only domestic providers accomplish the national goal of providing a reliable, affordable, and

²⁴ Todd Harrison, *Looking Ahead to the FY 2011 Defense Budget: A Review of the Past Decade and Implications for the Future Year Defense Program*, 15-17.

timely means by which the DoD can access to space, or is the DoD being used as a tool to maintain the domestic space launch industry?²⁵

To gain more insight into issue an examination of the governing space-related policies will help determine whether the DoD is using the proper strategy to fulfill its mission requirements. This section takes a holistic view of the governing policies to determine if the DoD is operating with a fiscally responsible strategy, one that preserves and limits national security concerns, or possibly a combination of both. In addition, this section evaluates the current trends and future implications that the current space related policies may hold for the DoD's access to space capability.

1. 2010 National Space Policy

The National Space Policy provides a broad overview of the nation's intended near- and long-term goals, along with guidance on how governmental agencies are to meet them. The 2010 National Space Policy was lauded by the Executive Branch's Office of Science and Technology Policy (OSTP), and the DoD as a policy that would emphasize the importance and necessity international cooperation would play in order for the U.S. government to meet the goals and priorities set forth in the 2010 National Space Policy.²⁶ Michael Nacht, the Assistant Secretary of Defense for Global Strategic Affairs, cited that the "flat" and "declining military space

²⁵ Executive Office of the President, National Science and Technology Council, *U.S. National Space Policy*, 14.

²⁶ Amy Klamper, "Obama Space Policy to Emphasize International Cooperation," *Space News*, November 30, 2009.

budgets" is one of the driving factors behind the self-proclaimed "dramatic overhaul" of America's National Space Policy.²⁷ However, the 2010 National Space Policy differs little from the 2006 National Space Policy in regards to bolstering and expanding the DoD's ability to maintain its assured access to space. In fact, the 2010 policy offers several contradictory policy goals that seek to bolster America's ability to access space, while helping to preserve America's national security posture.

While many of the tenets of the new space policy stress a renewed emphasis for more international cooperation, one area stands apart. The 2010 policy states that the United States must "enhance capabilities for assured access to space" and thus directs that "United States Government payloads shall be launched on vehicles manufactured in the United States."²⁸ Additionally, this policy assigns the Secretary of Defense with the responsibility to act as the space launch provider for both the defense and intelligence sectors with the goal to provide "reliable, affordable, and timely space access."²⁹

Intuitively, this disagrees with many of the other tenets of the policy, which ultimately stresses that to strengthen and energize America's space industry and our national defense, the nation must come to accept and promote international cooperation and actively explore the use of "inventive and nontraditional arrangements" for meeting of

²⁷ Turner Brinton, "International Cooperation Emphasis of Forthcoming U.S. Space Policy."

²⁸ Executive Office of the President, *U.S. National Space Policy*, 5.

²⁹ Executive Office of the President, *U.S. National Space Policy*, 14.

national goals.³⁰ However, the most contradictory point of this policy is that, while explicitly directing the DoD to use only domestic suppliers, it later directs the Secretary of Defense to implement "plans, procedures, techniques, and capabilities" to protect our national security posture by leveraging strategies that embrace allied and foreign cooperation.³¹ This string of discrepancies and contradictions has distorted how and why the DoD should use international cooperation to achieve the goals set forth in this policy, making it an ineffective tool to ensure the DoD accomplishes its mission in the most effective and efficient manner.

2. National Security Presidential Directive 40

As a direct result of guidance set forth in the U.S. National Space Policy, the Office of the President issued the U.S. Space Transportation Policy, which further defines the roles, responsibilities, and limitations of the DoD to achieve and maintain assured access to space. The U.S. Space Transportation Policy, also referred to as National Security Presidential Directive 40 (NSPD 40), outlines, in detail, the rationale for why the exclusive use of domestic space launch providers is prudent.

The fundamental goal of NSPD 40 defines a framework by which the government operates to ensure the continued capability to "access and use space" to support national

³⁰ Executive Office of the President, *U.S. National Space Policy*, 10.

³¹ Executive Office of the President, *U.S. National Space Policy*, 13.

security interests.³² The first critical point this directive establishes is that it defines for the DoD what assured access to space means to the DoD. The directive states assured access to space is a key component to national security and defines it as "sufficiently robust, responsive, and resilient capacity to allow continued space operations, consistent with risk management and affordability guidelines."³³ The second main point outlined is that it commits the DoD to use the EELV program for the "foreseeable future" to launch its payloads as long as it remains within "mission, performance, cost, and schedule requirements."³⁴ The final point of the directive clearly states that a viable domestic industrial base is the linchpin to maintaining America's access to space for national security concerns. It goes on to reiterate, once again, that all DoD payloads are to use domestic providers, unless specifically exempted by the Director of the Office of Science and Technology Policy and the Assistant to the President for National Security Affairs.³⁵

The policy does recognize, however, that the question of how to best achieve the mission requirements may not always lie in a domestic-only answer. The directive specifically recognizes that in situations where there is international cooperation readily available to develop and

³² Executive Office of the President, National Science and Technology Council, *U.S. Space Transportation Policy* (Washington, D.C.: Office of Science and Technology Policy, 2005), 2.

³³ Executive Office of the President, National Science and Technology Council, 3.

³⁴ Executive Office of the President, *U.S. Space Transportation Policy*, 3.

³⁵ Executive Office of the President, *U.S. Space Transportation Policy*, 7.

field systems, this restriction does not apply. This point is critical considering that the 2010 U.S. National Space Policy also emphasizes the need to engage and expand the amount of international cooperation the United States has concerning its space-related activities. The U.S. Space Transportation does an excellent job at defining the roles and responsibilities of the DoD in regards to assuring the nation's access to space. Unfortunately, the current policy, as with the U.S. National Space Policy, is contradictory in its proclamation as to the value of international cooperation while simultaneously restricting its use to assure the DoD efficiently employs its space launch strategy.

3. Homeland Security Presidential Directive 7 and Department of Defense Directive 3020.40

Established in 2002, the Department of Homeland Security's primary mission was to serve as the focal point to lead the national effort to protect America from those wishing to harm or disrupt our way of life.³⁶ Since that time, it has evolved to encompass many other missions, of which the protection of critical infrastructure is but one. The Homeland Security Presidential Directive 7 (HSPD 7) establishes a national policy that helps to prioritize critical infrastructure items and then outlines who has the overall responsibility to protect them. The NSPD 7 has

³⁶ Department of Homeland Security, "Strategic Plan: One Team, One Mission, Securing Our Homeland."

explicitly identified the DoD as the federal agency responsible to enforce and strengthen the defense industrial base.³⁷

In response to this assigned responsibility, the DoD issued DoD Directive (DoDD) 3020.40, which outlined the roles and responsibilities that the DoD would engage in to protect the defense industrial base. Throughout the directive, several sectors within the DoD were assigned the responsibility to "provide guidance to; monitor the activities of; and review, validate, and advocate funding" for the protection of key defense industry facilities and capabilities.³⁸ The directive goes on to indicate that the DoD should incorporate requirements for the risk management and mitigation of the defense industry into their acquisition and maintenance contracts.³⁹

While both HSPD 7 and DoDD 3020.40 seek to identify and define how the DoD should go about protecting the defense industrial base, it does a poor job at detailing exactly how far the government should go to "protect and preserve" these key resources. Such ambiguity, without clarification, leads to the speculation that one method of protecting the industrial base may be through the awarding of government

³⁷ Text of the Homeland Security Presidential Directive 7: Critical Infrastructure Identification, Prioritization, and Protection, as issued by the U.S. Department of Homeland Security on December 17, 2003, on the Department of Homeland Security's website.

³⁸ Department of Defense, *Department of Defense Directive 3020.40* (Washington, D.C.: Department of Defense, 2010), 7.

³⁹ Department of Defense, *Department of Defense Directive 3020.40*, 12.

procurement contracts to maintain a viable industry, regardless of whether it is in the department's best interests to do so.

**4. Policy Regarding Assured Access to Space:
National Security Payloads U.S. Code Title 10,
Section 2273**

The U.S. code title 10, section 2273) was amended in November of 2003 (to incorporate a new law concerning the DoD's procurement and sustainment of America's capability to access space. This piece of legislation guides the actions of the DoD's acquisition practice and is perhaps the most influential and unexplainable piece. The law states the DoD shall take appropriate actions to ensure its space launch capability is preserved, and specifically states the DoD must protect the following aspects of it:

(1) the availability of at least two space launch vehicles (or families of space launch vehicles) capable of delivering into space any payload designated by the Secretary of Defense or the Director of National Intelligence as a national security payload; and (2) a robust space launch infrastructure and industrial base.⁴⁰

Through the codification of these requirements, the DoD is legally obligated to sustain two domestic launch service providers and ensure that the industrial base must be maintained. While this law helps to preserve the DoD's ability to provide assured access to space, it fails to

⁴⁰ Cornell Law School, Legal Information Institute, "US Code: Title 10, Subtitle A, Part IV, Chapter 135, § 2273, Policy regarding assured access to space: national security payloads."

recognize that it may not be helping the DoD meet its mission requirements in the most efficient and effective manner possible.

B. THE EVOLVED EXPENDABLE LAUNCH VEHICLE PROGRAM

The Evolved Expendable Launch Vehicle (EELV) Program was born out of the necessity to replace the aging fleet of Atlas, Delta, and Titan launch systems with one that would ultimately reduce the cost of launching DoD and commercial satellites into space.⁴¹ The government at the time believed that this new program would not only replace the aging fleet, but would serve as a catalyst to improve the technology and manufacturing capability of the defense industrial base to make vehicles safer, more reliable, and ultimately result in cost savings for the DoD.⁴² In 1998, the Air Force, as the DoD executive agent for space, issued an Operational Requirements Document outlining what the government was trying to achieve in the acquisition and development of the EELV system. The overarching goals of the EELV program were threefold. First and foremost the EELV program was intended to provide the DoD with the means to assure its access to space and meet the department's peace and wartime requirements.⁴³ Second, the program was intended to lower the overall cost of space lift by reducing the acquisition and life-cycle cost by 25 to 50 percent,

⁴¹ Department of Transportation, *Special Report: The U.S. Evolved Expendable Launch Vehicle (EELV) Programs* (Washington D.C.: Department of Transportation, 1997), SR-1.

⁴² Department of Transportation, *Special Report: The U.S. Evolved Expendable Launch Vehicle (EELV) Programs*, SR-1.

⁴³ Richard Meyers, *Air Force Space Command Operational Requirements Document II for The Evolved Expendable Launch Vehicle System* (Washington D.C.: Department of the Air Force, 1998), 1.

making it more affordable given the current decline in the DoD's discretionary budget.⁴⁴ The third goal of the program was to enhance and bolster the American space launch industry, placing it into a better position to become more competitive in the international market and thus hoping to increase the United State's market share from 35 to 50 percent of the international market.⁴⁵

After several iterations of competitive concept validation, the DoD decide to enter into a partnership with industry to develop and field two competing systems. The DoD took this action with the hopes that, together, they could achieve the desired reduction in costs and meet the mission requirements for the next twenty years.⁴⁶ The Air Force awarded two EELV contracts in October 1998, with a combined value of \$2.03 billion, to Lockheed Martin with their Atlas V rocket and The Boeing Company with their Delta IV system. They were to supply the DoD with what was supposed to be a redundant capability from which they could assure their access space was preserved.⁴⁷

Unfortunately, many of the early forecasts and predictions that the EELV program were based upon turned out to be highly optimistic and eventually unachievable. The

⁴⁴ Meyers, *Air Force Space Command Operational Requirements Document II for The Evolved Expendable Launch Vehicle System*, 1; Department of Transportation, "Special Report: The U.S. Evolved Expendable Launch Vehicle (EELV) Programs," SR-1.

⁴⁵ Meyers, *Air Force Space Command Operational Requirements Document*.

⁴⁶ Linda Drake, James Knauf, and Peter Portanova, "EELV: Evolving Toward Affordability," American Institute of Aeronautics and Astronautics, Inc.

⁴⁷ Government Accountability Office, *Space Acquisitions: Uncertainties in the Evolved Expendable Launch Vehicle Program Pose Management and Oversight Challenges*, 7.

DoD and the Air Force were anticipating that the commercial launch market would continue to thrive. However, for numerous reasons, the commercial launch market collapsed, forcing the DoD to reevaluate its acquisition strategy, citing in 2003 that the expected launch costs were now 77 percent higher than its estimates from just a year prior.⁴⁸ The dramatic cost overrun flagged the program as being in violation of the Nunn-Mccurdy cost breach threshold set forth in Title 10 USC section 2433.⁴⁹ Therefore, based on preserving national security, the Secretary of Defense, with concurrence from Congress, was forced to authorize the establishment of a new cost baseline that increased the future estimated launch costs by 29 percent due to additional anticipated shortfalls.⁵⁰

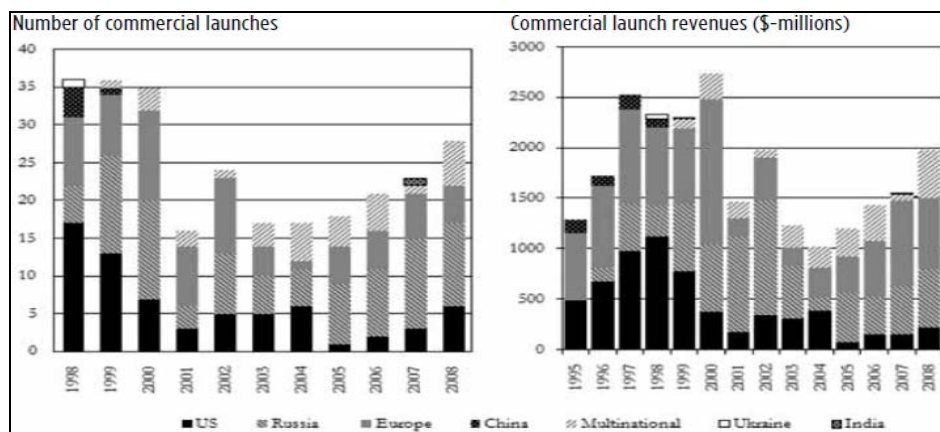


Figure 1. Worldwide Commercial Space Launches⁵¹

⁴⁸ Government Accountability Office, *Space Acquisitions: Uncertainties in the Evolved Expendable Launch Vehicle Program Pose Management and Oversight Challenges*, 7.

⁴⁹ Department of Defense, "Nunn-Mccurdy (NM) Unit Cost Breaches."

⁵⁰ Government Accountability Office, *Space Acquisitions: Uncertainties*.

⁵¹ Jessica West, *Space Security 2009* (Kitchner, Ontario: Pandora Press, 2009), 90.

In 2005, the realization finally set in that the government had become the primary consumer of the domestic market, and the DoD set out once again to realign the EELV program to meet the needs being dictated by the market. This change was concurrent with the Boeing Company and Lockheed Martin entering into a joint venture, which would ultimately combine all aspects of their respective space launch capability into a single source. The goal was to maximize their efficiencies to provide the DoD with assured access to space with what they hoped would be a significant reduction in cost.⁵² The new joint venture became known as The United Launch Alliance (ULA).

C. REALITIES OF THE DOD'S ASSURED ACCESS TO SPACE PROGRAM

The DoD's ability to continue to provide a reliable, affordable, and timely mechanism by which to maintain America's assured access to space is becoming more difficult every day. The strategy the DoD constructed relies upon a healthy and robust commercial space launch market from which a commercially driven market would foster technological innovation, while reducing the cost per launch for the government. Unfortunately, ever since the commercial space launch market dried up in the early part of this decade, the DoD has been struggling to find the proper level of government and industrial partnership that would assure the DoD could meet its mission requirements while preserving and creating a viable industrial base.

⁵² Government Accountability Office, *Space Acquisitions: Uncertainties in the Evolved Expendable Launch Vehicle Program Pose Management and Oversight Challenges*, 7-8.

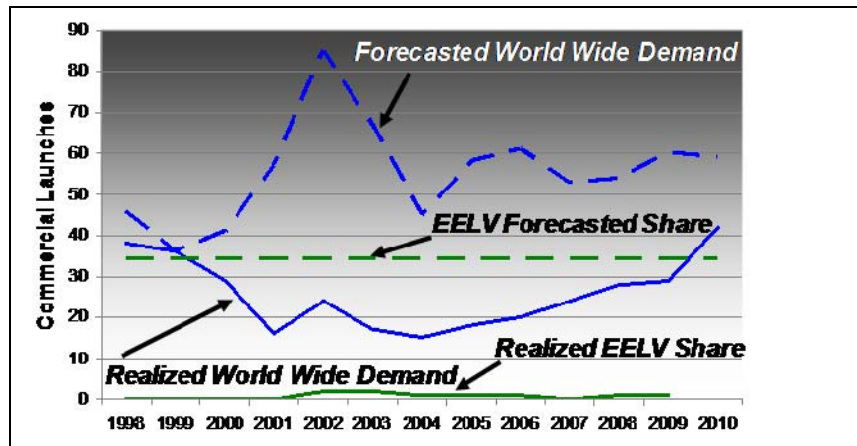


Figure 2. World Wide Demand vs. Forecasted Predictions⁵³

1. UNSTABLE COST GROWTH AND INACCURATE FORECASTS

When the DoD began exploring the many options to ensure its continued access to space, reducing the overall cost of space launch was one of the top priorities, with a goal of achieving cost savings of 25 to 50 percent over the heritage launch systems.⁵⁴ Unfortunately, one of the biggest problems affecting the success of the DoD's EELV program has been its inability to accurately forecast and control the cost of the program. A recent study conducted by the Center for Strategic and Budgetary Assessments indicates that the fastest-growing area of DoD procurement has been space

⁵³ Curt Khol and John Tomick, "EELV Program Assessment" (PowerPoint Presentation, OSD CA, March 12, 2010), 10.

⁵⁴ Meyers, *Air Force Space Command Operational Requirements Document (ORD) II for The Evolved Expendable Launch Vehicle System*, 1.

systems, increasing from a real annual rate of \$1.0 billion per year to \$4.6 billion per year during this the past decade.⁵⁵

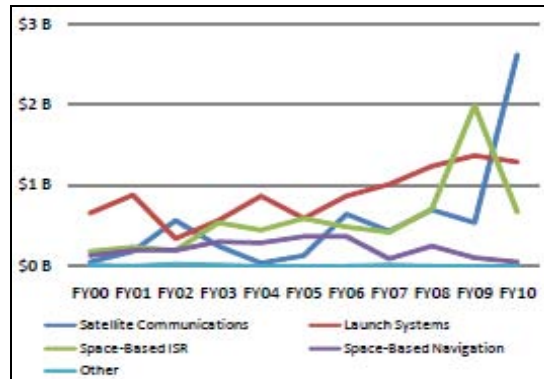


Figure 3. Space Systems Procurement Funding (in billions of FY10 dollars)⁵⁶

Table 1. Top DoD Space Systems Procurements⁵⁷

Program	FY10 Request
Advanced EHF	\$1,843,475
Evolved Expendable Launch VEH (EELV)	\$1,295,325
Fleet Satellite Comm Follow-on (MUOS)	\$516,127
SBIR High	\$466,456
Wideband Gapfiller Satellites (WGS)	\$264,051
Defense Space Recon Program	\$105,152
Defense Meteorological Sat Program	\$97,764
Global Positioning System	\$53,140
Natl Polar-Orbiting OP ENV Satellite	\$3,900

⁵⁵ Harrison, *Looking Ahead to the FY 2011 Defense Budget: A review of the Past Decade and Implications for the Future Year Defense Program*, 15.

⁵⁶ Harrison, *Looking Ahead to the FY 2011 Defense Budget: A review of the Past Decade and Implications for the Future Year Defense Program*, 14.

⁵⁷ Harrison, *Looking Ahead*, 17.

More specifically, the funding allocated to procure launch systems and maintain supporting infrastructure comprised more than 39 percent of the 2010 space system's overall budget and was second in total spending forecasts for Fiscal year (FY) 2010, with \$1.3 billion of the cost increase attributed to uncontrollable costs and the inability to deliver products and services on schedule.⁵⁸

In 2004, the GAO performed an assessment to determine whether the EELV program was actually meeting the DoD's goal of providing assured access to space at a reduced cost to the government. The report indicated that the EELV program was making progress in achieving its goal, but because of the significant cost increases, the program office would ultimately be forced to alter its acquisition strategy.⁵⁹ Specifically, the GAO noted that the program's costs increased by \$13.3 billion over the 2002 program baseline of \$18.8 billion, of which nearly \$11 billion was attributed to the incorrect assumptions about the viability of the commercial market and incorrect pricing forecasts.⁶⁰

Similarly, an internal assessment conducted by the U.S. Air Force in March 2010 revealed that the DoD continues to struggle in providing accurate forecasts in regards to space launch, and were forced to rely on overoptimistic contractor-provided estimates on which to base future

⁵⁸ Harrison, *Looking Ahead*, 16-17.

⁵⁹ Government Accountability Office, *Defense Space Activities: Continuation of Evolved Expendable Launch Vehicle Program's Progress to Date Subject to Some Uncertainty* (Washington, D.C.: Government Accountability Office, 2004), 3-8.

⁶⁰ Government Accountability Office, *Defense Space Activities*, 7-8.

funding requests.⁶¹ This factor is seen readily when comparing the EELV program's current and original forecast to those of other major space acquisition programs, as depicted in Figure 4. The EELV program has outpaced its original estimate by nearly 100 percent since the business case for EELV was presented and accepted by the DoD.

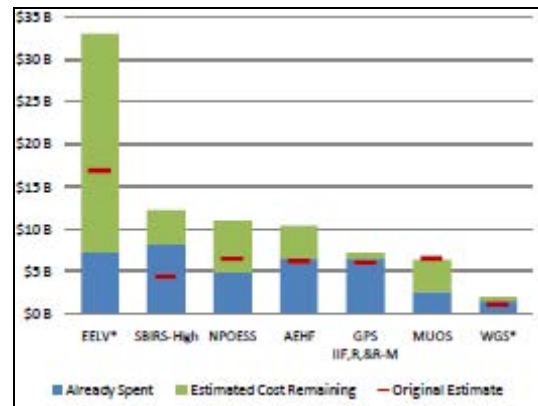


Figure 4. Current vs. Original Estimates for Major Systems⁶²

Regardless of the magnitude of these overruns and the inaccuracies of its forecasts, the DoD is continuing to use optimistic estimates from ULA on which to base FY 2010 to FY 2015 budget, hoping to realize more than \$105 million in savings per year beginning in FY 2011.⁶³ The DoD predicts these savings will materialize based on anticipated programmatic efficiencies over the next four years. Despite this optimistic approach, the EELV program requirements are still projected to overrun the allocated budget by more than

⁶¹ Government Accountability Office, *Space Acquisitions*, 17-18; Curt Khol and John Tomick, "EELV Program Assessment," 19-22.

⁶² Harrison, *Looking Ahead*, 16.

⁶³ Government Accountability Office, *Space Acquisitions*, 17-18.

\$3.3 billion between 2011 and 2015, leading one to believe that the current system and methodology is unsustainable.⁶⁴

2. DEVELOPING A RELIABLE SYSTEM

The second major goal of the EELV program was to develop and procure a reliable system for the DoD to use in launching its payloads to replace the ageing heritage systems.⁶⁵ In regards to this priority, the DoD and the EELV program have performed within their targeted goals: Launching 30 missions without a catastrophic failure and maintaining an average reliability factor of 81.5 percent for the Delta-IV system and 89.7 percent for the Atlas-V system.⁶⁶ However, DoD officials cautiously warn that the EELV program is still in its infancy when compared to the heritage programs, which had 232 successful launches and whose reliability factors range between 85.4 percent for the Titan-IV system and 98.0 percent for the Delta-II system.⁶⁷

⁶⁴ Khol and Tomick, "EELV Program Assessment," 22.

⁶⁵ Meyers, *Air Force Space Command Operational Requirements Document (ORD) II for The Evolved Expendable Launch Vehicle System*, 1.

⁶⁶ The Reliability factor is determined by the vehicle's ability to complete the entire mission from launch to placement of the satellite in its intended orbital target; Joe Tomei, "EELV Decision History" (PowerPoint Presentation, The Aerospace Corporation, 2008), 16.

⁶⁷ Tomei, "EELV Decision History," 16.

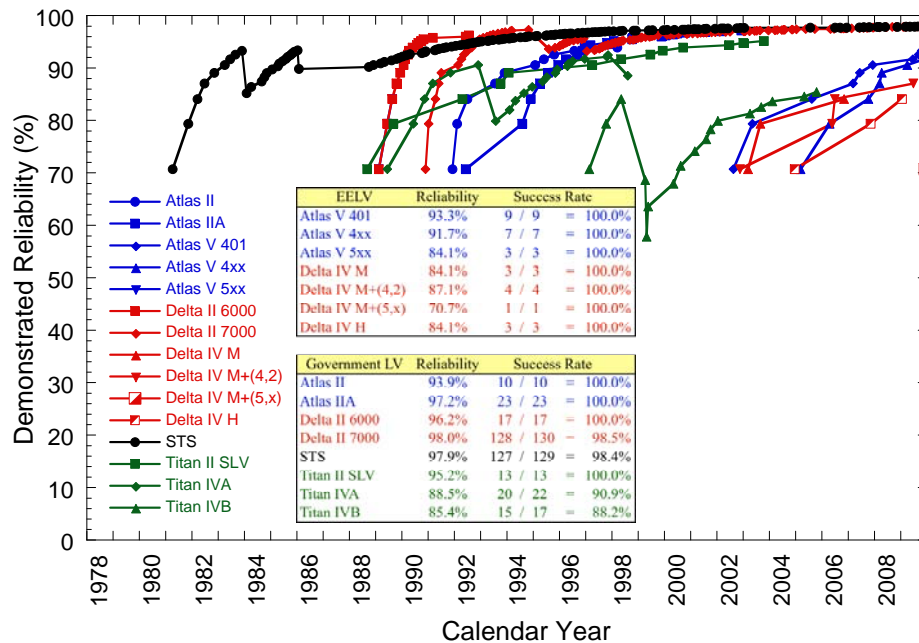


Figure 5. Reliability of EELV and Heritage Systems⁶⁸

Perhaps the biggest technical risk identified within the EELV program deals with the inability of the government and industry partners to hire and retain appropriately trained personnel. Numerous GAO investigations have revealed that the workforce in both the government's EELV program office and those of the industrial base are becoming anemic.⁶⁹ Both are lacking the "technical expertise to develop highly complex space systems," a fact that is attributed to an overall shortage of qualified scientists and aerospace engineers.⁷⁰ As part of the GAO investigation, it was also discovered that the Air Force's program office

⁶⁸ Tomei, "EELV Decision History," 16.

⁶⁹ Chaplain, *Space Acquisitions: Government and Industry Partners Face Substantial Challenges in Developing New DOD Space Systems*, 11-12; Chaplain, *Space Acquisition: DOD Faces Substantial Challenges in Developing New Space Systems*, 10-14.

⁷⁰ Chaplain, *Space Acquisition*, 10-14.

was not only deficient in the number of technically qualified individuals (currently under 67 percent manned to requirements), but there were also deficiencies in the proper mix of personnel, in general. These deficiencies would preclude the program office from effectively managing the cost reimbursement acquisition contract used to procure the EELV system, hampering their overall ability to complete their current workload.⁷¹ With personnel shortages from both the industry and the government program office, the risk of being unable to deliver reliable launch systems on schedule, and maintain realistic cost baselines, becomes problematic.

D. CONCLUSION

The laws and policies concerning the actions of the DoD are clear in regards to how it should go about preserving its access to space. Codified in policy and law, the DoD must use and preserve two domestic suppliers, which will ultimately support the goal of enhancing our national security through the preservation of what has become viewed as a key defense industry. Unfortunately, the very policies directed to preserve this capability may be creating an unaffordable spending environment, while simultaneously weakening the American space launch industry's ability to compete in the world market because of their reliance on government patronage and subsidies.⁷²

By all measures, the EELV program does in fact offer great potential to the DoD as a safe and reliable system.

⁷¹ Chaplain, *Space Acquisition*, 14, 25-28.

⁷² Jessica West, *Space Security 2007* (Waterloo, Ontario: Project Ploughshares, 2007), 79.

The program has met most of its technical milestones and is achieving a mission reliability factor that is in line with expectations. Despite this success, the DoD and ULA are still struggling to find efficiencies that will help them to better understand and control the escalating costs the DoD is paying to keep the industry viable.⁷³ Regrettably, this concern is amplified by the fact the DoD and its industry partners cannot seem to attract and retain the proper mix of personnel possessing the right mix of technical and programmatic skills required to manage a program of this size and complexity.

Furthermore, the progress the DoD has made to date to contain costs and provide forecasts that are more accurate to senior leaders within the DoD and Congress may become challenged once again. With the recent decision to terminate NASA's Constellation program, the economies of scale that were helping to lower the cost of the EELV program to the DoD may be lost, resulting in the DoD being forced to absorb the rising costs once again in order to preserve the viability of the ULA.⁷⁴ These points reinforce the validity of questioning whether the DoD can afford to continue with the current strategy of maintaining access to space, or whether it is time to consider an alternative strategy.

⁷³ Stephen Clark, "Air Force Seeks Efficiencies for America's Rocket Fleet," *Spaceflight Now*, March 29, 2010.

⁷⁴ Doug Messier, "Air Force Wrestles with EELV Launch Costs as NASA Weighs Options."

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III. ANALYSIS OF DOMESTIC AND FOREIGN SUPPLIERS

This chapter addresses the DoD's technical requirements inherent to launching its systems and then analyzes the capability, reliability, costs, and potential national security concerns associated with these various launch systems. While numerous states and international consortiums throughout the world are certainly capable of launching DoD satellites, this assessment focuses only on those entities with which the United States currently has amicable relationships. These systems are the focus of the EELV program alternatives that should be considered for use by the DoD.

This chapter begins by defining, on a broad scale, what the technical launch requirements are for the current suite of DoD satellites. Next, this chapter examines the capability, reliability, and costs of the DoD's current space launch provider, United Launch Alliance. Finally, the chapter presents three foreign space launch providers whose system's capability and reliability are such that the DoD could, from a technical standpoint, use their services, as a viable alternative to achieve the nation's assured access to space requirement.⁷⁵

A. DEPARTMENT OF DEFENSE SATELLITE SYSTEMS

The primary mission of the DoD's space systems is to provide the nation with the capability to conduct and

⁷⁵ The three alternative space launch providers presented are the European Union's Arianespace Consortium, Japan's Aerospace Exploration Agency, and the Sea Launch Consortium.

support military operations from and through space to enhance our military affectivity and to bolster America's Homeland Security and National Defense.⁷⁶ The DoD accomplishes this by means of the U.S. Navy and Air Force procuring meteorological, communications, navigation, and early warning satellites systems (Table 2) from companies within the domestic defense industrial base. Once the satellites have been built and adequately tested, they are shipped to the launch site where they are integrated and launched from a medium class EELV rocket.

Table 2. Current DoD Unclassified Programs⁷⁷

CURRENT DoD PROGRAMS	FUNCTION	ORBIT	WEIGHT Lbs (Kg)	MANUFACTURER
Defense Meteorological Satellite Program (DMSP)	Meteorology	LEO	2,720 (1,233)	Lockheed Martin
National Polar-Orbiting Operation Environment Satellite System (NPOESS)	Meteorology	LEO	14,498 (6,576)	Northrup Grumman
Advanced Extremely High Frequency (AEHF) System	Communications	GEO	13,421 (6,087)	Lockheed Martin
Mobile User Objective System (MUOS)	Communications	GEO	6,800 (3,084)	Lockheed Martin
Wideband Global Satcom (WGS)	Communications	GEO	10,262 (4,655)	Boeing
Global Positioning System (GPS)	Navigation	MEO	4,485 (2,035)	Lockheed Martin/Boeing
Space Based Infrared Systems (SBIRS) High	Early Warning	GEO	10,229 (4,640)	Lockheed Martin

⁷⁶ Department of the Air Force, *Air Force Doctrine Document 2-2* (Washington D.C.: Department of the Air Force, 2006), 1.

⁷⁷ Department of the Navy, "MUOS Mobile User Objective System," accessed August 20, 2010, https://acquisition.navy.mil/rda/home/programs/information_communications/muos; Department of the Air Force, *The Air Force Handbook: 2007* (Washington D.C.: Department of the Air Force, 2007), 33-255; LEO is the abbreviation for a low Earth orbit, MEO is the abbreviation for a medium Earth orbit, HEO is the abbreviation for a highly elliptical orbit, and GEO is the abbreviation for a geosynchronous Earth orbit.

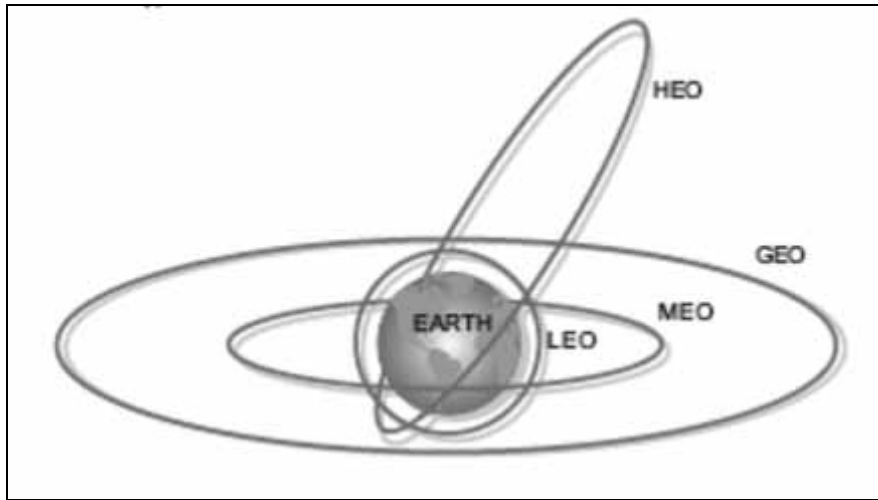


Figure 6. Types of Satellite Earth Orbits⁷⁸

B. UNITED STATES' EVOLVED EXPENDABLE LAUNCH VEHICLE

To meet its access to space requirements, the DoD has supported and contracted with a joint venture between The Boeing Company and Lockheed Martin, known as the United Launch Alliance. As previously noted, the system is comprised of two classes of vehicles with varying levels of launch capability between them. Altogether, the EELV program can satisfy the performance and orbital capability required to launch the suite of DoD satellites listed in Table 2. Since its first launch in 2002, the EELV program is viewed as a success story in terms of its performance and reliability for a new system, successfully launching its first thirty missions with an average reliability rating of 81.5 and 89.7 percent, respectively, for the Atlas-V and Delta-IV systems.⁷⁹

⁷⁸ West, *Space Security 2009*, 26.

⁷⁹ Tomei, "EELV Decision History," 16.

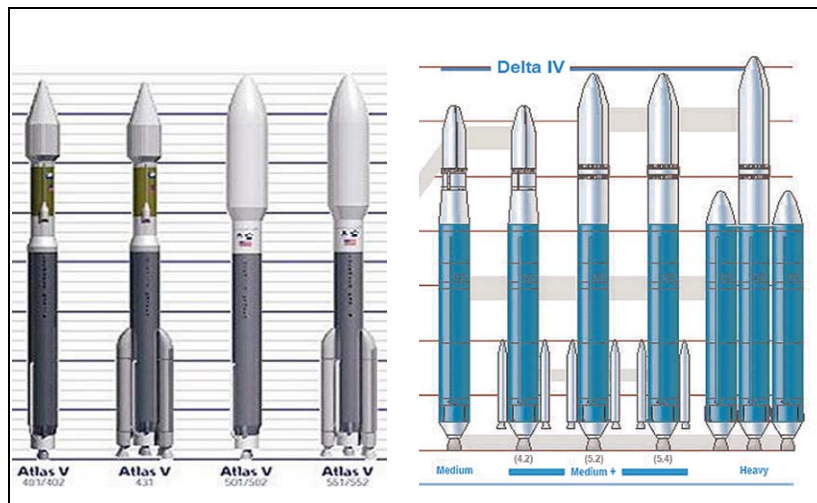


Figure 7. Atlas V and Delta IV Launch Vehicles⁸⁰

Table 3. EELV System Capability⁸¹

	ATLAS V SYSTEM			DELTA IV SYSTEM			
	410	431	551	Medium	M+(4,2)	M+(5,4)	Heavy
GTO	4,750 kg	7,700 kg	8,900 kg	4,300 kg	6,030 kg	7,020 kg	12,980 kg
	10,470 lb	16,970 lb	19,260 lb	9,480 lb	13,290 lb	15,470 lb	28,620 lb
LEO	9,370 kg	15,130 kg	18,510 kg	9,150 kg	12,240 kg	13,360 kg	22,560 kg
	20,650 lb	33,650 lb	40,800 lb	20,170 lb	26,980 lb	29,450 lb	49,740 lb

Trying to determine the precise cost the DoD pays to launch a satellite is difficult. Prior to EELV, when the government manifested a satellite for launch from a certain rocket system, it would contract directly with the service provider and pay a set price for the service. However, since the collapse of the commercial space launch market,

⁸⁰ Khol and Tomick, "EELV Program Assessment," 7.

⁸¹ "Delta IV: The 21st Century Launch Solution"; "Atlas V: Maximum Flexibility and Reliability."

the U.S. government has become the primary customer for ULA, and with that has come the burden of also paying for the infrastructure and sustainment costs associated with maintaining ULA's ability to safely and reliably launch satellites for the DoD. Unofficial figures place the cost per launch starting from \$70 million and increasing up to \$140 million for the Delta IV Heavy rocket.⁸² Unfortunately, this cost does not reflect the amount the DoD is actually paying for this service. Figure 8 depicts what the cost per vehicle class would be when infrastructure costs are factored into the equation (assuming a total of eight EELV launches).

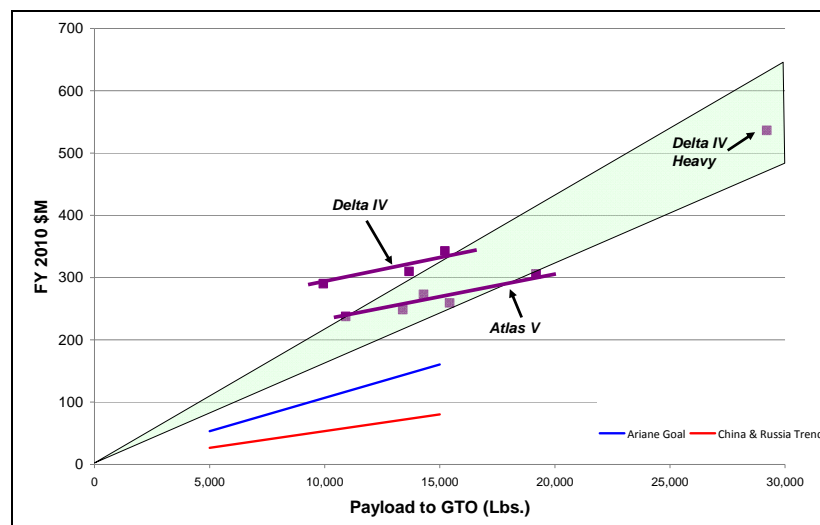


Figure 8. EELV Price vs. Performance Plot⁸³

The reality is that, in the 2010 National Security Space budget, the DoD requested \$1.393 billion to launch

⁸² Andrews Space and Technology, "Space and Tech: Delta IV Specifications"; Andrews Space and Technology, "Space and Tech: Atlas V Specs."

⁸³ Khol and Tomick, "EELV Program Assessment," 19.

just five satellites from EELV boosters.⁸⁴ This equates to the DoD paying more than \$280 million per launch in FY 2010. The exact amount, however, depends not only on the configuration of the system purchased, but on how many launches ULA will actually launch that year, from which it can allocate its infrastructure and sustainment costs.

C. FOREIGN LAUNCH SYSTEMS

Since the beginning of this decade, the United States, along with the rest of the world's space-faring nations, have seen an overcapacity in the space launch market, driven by the belief that the commercial demand of the 1990s would continue into the foreseeable future.⁸⁵ This trend has resulted in a surplus of safe and efficient launch systems from which the DoD could choose to meet mission requirements or to augment the existing EELV program. In fact, the market's overcapacity makes the cost of launching satellites a more tangible decision point that the DoD should considered as part of its overall strategy. However, this reality stands in stark contrast to a recent RAND report that asserts that "launch economics" cannot, and should not, be measured using the classical model of supply and demand, since the industry is so heavily subsidized, citing that its economics are driven by the demand for capability while keeping costs low.⁸⁶ This statement, however, does not

⁸⁴ James Mazol, *Considering the FY 2010 National Security Space Budget* (Washington D.C.: George C. Marshall Institute Policy Outlook, 2009), 3.

⁸⁵ West, *Space Security 2009*, 83.

⁸⁶ Forest McCartney, *National Security Space Launch Report* (Santa Monica, CA: RAND Corporation, National Defense Research Institute, 2006), 27.

obviate the fact that the cost to launch a satellite constitutes between 35 and 50 percent of the total cost of acquiring the satellite for operation.⁸⁷ A staggering figure when one assumes that many of the satellites procured by the DoD can cost upwards of \$1 billion.

For the DoD, however, the cost to launch systems into space does not appear to be the driving factor governing its assured access to space policies. The next section presents an overview of the foreign space launch systems that are capable of reliably delivering the DoD's payloads to orbit. While there are nine nations and consortiums that have the capability to launch satellites into space, this assessment focuses on addressing the capabilities and efficiencies of three due to national security and logistical reasons. The three viable alternatives to ULA's EELV program are offered through the European Union's Arianespace, Japan's Aerospace Exploration Agency (JAXA), and the Sea Launch international consortium.

1. European Union's Arianespace Consortium

The European Union's European Space Agency's (ESA) is Europe's answer to NASA and the DoD space program rolled into one. The organization is very similar in operation and capability to that of the United States' EELV program, but has several distinct qualities setting it apart from its American counterpart. The primary difference is that the organization is built around a consortium of eighteen member nations who collectively contribute to the ESA to ensure

⁸⁷ McCartney, *National Security Space Launch Report*, 32.

that Europe will have assured access to space from which to actively launch commercial and defense-related systems.⁸⁸

As with the development and sustainment of the EELV program, ESA has developed their Ariane rocket system with the help of government subsidies from EU member nations, providing a form of "Launch Aid" to ensure the ESA could develop a system capable of safely launching any system into space.⁸⁹ Ironically, the United States has been a vocal opponent of ESA within the World Trade Organization (WTO), arguing that the EU is contributing too much funding to the development and sustainment of ESA, citing that government subsidies should only be used to facilitate infancy industry growth, not to be used as part of a government's technology and strategic trade policies.⁹⁰

Next to the EELV launch system, the ESA's rocket systems are some of the most technically advanced and capable launch systems in the world. In fact, the Ariane system is considered by many in the space launch community to be superior to the EELV system, due in large part to the location of its launch facility. ESA has constructed its launch site at Kourou, located in French Guiana. This site offers the advantage of being only 500-km north of the equator, enabling it to launch payloads more efficiently

⁸⁸ The 18 member nations that contribute to ESA are Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. European Space Agency, "ESA: Space for Europe."

⁸⁹ Kim Kaivanto, "Premise and Practice of UK Launch Aid," *Journal of World Trade* 40, no. 3 (2006), 495.

⁹⁰ Kaivanto, "Premise and Practice of UK Launch Aid," 495-497; Bill Lai, "National Subsidies in the International Commercial Launch Market," *Space Policy* 9 (February 1993), 17-23.

into orbit by taking advantage of the "slingshot effect" gained from launching satellites near the equator and not having to significantly alter the satellite's trajectory if it is headed to a geostationary orbit.⁹¹

In addition to the advantage its launch site has to offer, the Ariane system has developed into a capable and reliable system. The family of Ariane vehicles are capable of launching payloads ranging in weight from 10,500 kg to a geo-transfer orbit (GTO) and up to 21,000 kg to a low Earth orbit, making it an ideal system to launch medium class satellites and, more specifically, capable of supporting any and all of the DoD's current system requirements. In terms of its reliability, the Ariane 5 system has exceeded expectations and has successfully launched forty-two out of forty-four rockets since its creation in 1996, giving it a 96 percent reliability factor.⁹² In an effort to enhance their space launch capability, the ESA entered into a partnership with the Russian space giant Starsem to bring the Soyuz launch system to their spaceport in French Guiana in 2008. This capability will further bolster Arianespace's ability to launch medium class satellites with greater capacity and frequency, further reducing costs to their customers. In addition to meeting the mission capability requirements of the DoD payloads, the reliability of the Soyuz system over the past decade has been 99 percent, successfully launching 93 out of 94 missions.⁹³

⁹¹ European Space Agency, "ESA: Europe's Spaceport Launchers."

⁹² West, *Space Security 2009*, 173.

⁹³ West, *Space Security 2009*.

Table 4. Capability of European Union's
Arianespace Systems⁹⁴

	Soyuz	Ariane 5
GTO	1,350 kg	10,500 kg
	2,977 lb	23,148 lb
LEO	6,708 kg	21,000 kg
	14,789 lb	46,298 lb

In terms of affordability, Arianespace advertises that the cost to procure and launch one of its systems ranges from \$35 to \$45 million for its Soyuz class vehicle, and approximately \$120 million for its larger Ariane 5 class vehicles, thereby placing its cost per throw weight capability at a level far below the \$280 million average per launch price the DoD is paying for the EELV system.⁹⁵

The ESA's Arianespace system should be viewed as an attractive alternative to the EELV program for several reasons. First, from a technical and systems perspective, the EU's Arianespace offers launch systems that do indeed meet the technical requirements of current DoD satellite system. Second, it has been shown that the DoD can achieve a cost saving of up to \$200 million per satellite if the DoD were to contract for a commercial launch service with Arianespace, either directly or through the DoD satellite manufacturer, as is common practice in the commercial market. Finally, there appears to be no national security concern with launching DoD satellites from an allied

⁹⁴ West, *Space Security 2009*, 173.

⁹⁵ This cost figure does not include the cost to transport and process the satellite for launch once it arrives at the launch site. Andrews Space and Technology, "Space and Tech: Ariane 5 Specifications."

nation's spaceport with which the DoD is actively collaborating with to broaden and expand cooperation in numerous other space-related matters per the 2010 National Space Policy.

2. Japan's Aerospace Exploration Agency

The Japanese space program was borne out of a cooperative mindset, both from the need for technological support as well as its pacifist role within the Asian Pacific region. The Japanese space program began in 1955, but it was not until it collaborated with the U.S. in 1969 that its space launch capability began to develop. The United States entered into an agreement known as the Exchange of Notes Concerning Cooperation in Space Exploration, where the United States allowed the transfer of technology necessary to develop a domestic space launch capability to Japan in an effort to foster the growth of their space program while simultaneously building a stronger alliance between the two nations.⁹⁶ The Japanese National Space Development Agency, therefore, collaborated with the McDonnell Douglass Corporation to build a version of its Delta rocket system, which eventually evolved into their H-IIA/B system in use today.⁹⁷ The provisions of the transfer, however, prohibited Japan from re-exporting the technology, which meant they could not rely on the technology to build a successful commercial space launch

⁹⁶ Kurt M. Campbell and Christian Beckner, *U.S. Japan Space Policy: A Framework for 21st Century Cooperation* (Washington D.C.: Center for Strategic and International Studies, International Security Program, 2003), 10.

⁹⁷ Steve Berner, *Japan's Space Program: A Fork in the Road*, (Santa Monica, CA: RAND Corporation, National Defense Research Institute, 2005), 1-5.

market.⁹⁸ The effects of this agreement are still seen today in the capability and maturity of Japan's space launch industry.

In the years since the American investment in the Japanese space program, the Japanese Aerospace Exploration Agency (JAXA) formed a partnership with Mitsubishi Heavy Industries and Ishikawajima-Harima Heavy Industries to develop their current space launch capability, the H-IIA/B rocket system. The H-II system does not have a long and storied history due in large part to the lack of public support for a domestic space program, which translated into a minimal investment by the government to support and promote a commercially competitive program. However, the new systems are capable of launching most of the DoD satellite systems into their intended orbits, with the exception of the Air Force's AEHF system, which currently surpasses the capabilities of the H-IIA's lift capacity to GTO.

Table 5. Capability of Japan's H-2A Rocket System⁹⁹

	H-IIA	H-IIB
GTO	6,000 kg	N/A
	13,228 lb	N/A
LEO	10,000 kg	16,500 kg
	22,047 lb	36,377 lb

⁹⁸ Berner, *Japan's Space Program*, 3.

⁹⁹ "JAXA: H-IIA Launch Vehicle," accessed October 14, 2010; "JAXA: H-IIB Launch Vehicle."

In terms of reliability, the initial H-II variant was plagued with infancy issues that resulted in two catastrophic failures of the H-II system in 1998 and 1999. However, since those two failures, JAXA appears to have resolved their rocket's issues and have since successfully launched each of their last fifteen missions manifested for the H-IIA/B, giving the system a reliability factor of 100 percent.¹⁰⁰ This success rate, coupled with a cost-per-mission ranging from \$100 to \$140 million per launch, makes JAXA's H-IIA/B an attractive alternative for consideration by the United States for use in launching DoD satellites.

Just as proponents argued that international cooperation between the DoD and the ESA could foster a stronger alliance between the United States and the EU, many believe that another agreement between Japan and the United States to cooperate on matters of space launch could prove beneficial.¹⁰¹ Japan is already a strategic U.S. ally in the region, but one that is currently restricted by its own ability to project power, thereby becoming a stronger ally in the region, helping to deter many of the aggressive actions by North Korea and China. In a recent report, the Center of Strategic and International Studies asserts that there is a "mutual dependency" between the United States and Japan to develop and strengthen Japan's regional security

¹⁰⁰ Campbell and Beckner, *U.S. Japan Space Policy: A Framework for 21st Century Cooperation*, 13.

¹⁰¹ Campbell and Beckner, *U.S. Japan Space Policy: A Framework for 21st Century Cooperation*, 13; Berner, *Japan's Space Program: A Fork in the Road*, 36-37.

and protection, and that the key to accomplishing this was through more cooperation, specifically through enhancing their space-based capabilities.¹⁰²

However, several factors may pose a problem to launching DoD payloads from the H-IIA/B system, the primary of which is still the protection of sensitive information and technology. Several instances over the past twenty years have reinforced this belief. In the 1990s, there were several instances where it was suspected that several U.S. domestic satellite corporation's proprietary technology was stolen by China in an effort to enhance their own capabilities.¹⁰³ To further exacerbate the situation, it was noted on several occasions in the past ten years that Japan might have serious security concerns when it comes to protecting sensitive information, not only from domestic organized crime syndicates, but also from foreign espionage perpetrated by North Korea and China.¹⁰⁴ These factors give credence to the belief that launching DoD satellites from Japan, or any other foreign nation, may jeopardize the security and protection of American technology as well as sensitive national security information employed by the DoD and its industry partners, thereby threatening our national security.

¹⁰² Campbell and Beckner, *U.S. Japan Space Policy: A Framework for 21st Century Cooperation*, 16.

¹⁰³ James Mintz, "Missile Failures Led to Loral-China Link," *Washington Post*, June 12, 1998, sec. A; Kurt M. Campbell, "U.S. Japan Space Policy: A Framework for 21st Century Cooperation," 11.

¹⁰⁴ Campbell and Beckner, *U.S. Japan Space Policy: A Framework for 21st Century Cooperation*, 11.

3. Sea Launch

Sea Launch is a multinational endeavor established in 1995 between The Boeing Company's Space Systems, Russia's RSC-Energia, Norway's Aker Kvaerner, and Ukrainian's SDO Yuzhnoye/PO Yuzhmash corporations.¹⁰⁵ The premise of the venture is simple; rather than processing and launching satellites from a land-based facility, Sea Launch developed a new approach where the rocket and satellite are processed for launch on land, then transported via a converted floating oil rig into the Pacific Ocean to be launched at the equator. This option is beneficial for numerous reasons. First, by creating a hybrid system, Sea Launch is able to process the rocket and satellite from its port facilities in Long Beach, California, thereby offering a domestic processing facility. This would enable the DoD to maintain positive control and access to their satellite systems, thus minimizing their concerns for the inadvertent transfer of technology to foreign nationals.

The second major advantage that Sea Launch offers is that it is capable of launching the system into orbit from the equator, thus eliminating the need to perform any additional plane changes for satellites being launched into a geosynchronous orbit. This enables the system to take advantage of the rotation of the Earth to help "slingshot" the rocket into orbit, ultimately saving fuel and thus prolonging the life of the satellite once in orbit.¹⁰⁶

¹⁰⁵ Cesar Jaramillo, *Space Security 2010* (Kitchner, Ontario: Pandora Press, 2010), 108.

¹⁰⁶ Rob Peckham, "Sea Launch: Providing Assured Commercial Access to Space," *High Frontier* 3, no. 1 (November 2006), 53.

The Sea Launch system centers around the Zenit-3SL rocket system built cooperatively between Russia's RSC Energia, the Ukraine's SDO Yuzhnoye/PO Yuzhmash, and the Boeing Corporation. The Zenit-3SL system is a derivative of the Russian Zenit-2 system, but was subsequently modified with a third-stage motor to help deliver its payload into orbit without sacrificing any capability. As mentioned earlier, due to its ability to launch from the equator, the Zenit-3SL system is capable of launching heavier systems into space without sacrificing fuel. Ultimately, the Sea Launch system is capable of launching the entire spectrum of DoD payloads into geosynchronous or low Earth orbit.

Table 6. Capability of Sea Launch's Zenit-3SL System¹⁰⁷

	Zenit-3SL
GTO	6,100 kg
	13,440 lb
LEO	15,246 kg
	33,541 lb

In terms of system reliability, the Sea Launch system has successfully delivered thirty-one of its thirty-three missions to the desired target orbit, resulting in a success rate of 93.9 percent and a reliability rate of 92.2 percent.¹⁰⁸

¹⁰⁷ West, *Space Security 2009*, 174; Pfaltzgraff, *Space and U.S. Security: A Net Assessment*, 13.

¹⁰⁸ Jaramillo, *Space Security 2010*, 180; Gary Henry, "Spacelift 2010-2030: A National Security Space Perspective" (PowerPoint presentation presented at the annual AIAA Los Angeles Section Dinner, Los Angeles, CA, 14 January 2009), 18.

The Sea Launch consortium is not without its limitations and shortfalls. In June of 2009, the commercial consortium filed for Chapter 11 bankruptcy, unable to survive the faltering space launch economy under its current operational structure.¹⁰⁹ Then, in July of 2010, just thirteen months after filing for bankruptcy, the consortium announced that it has reached an agreement to stay in business by restructuring its holding and shareholders.¹¹⁰ The major restructuring within Sea Launch was with the Russian space giant Energier, bid to acquire 85 percent ownership in the company, thereby removing The Boeing Company from the leadership role.¹¹¹ This change in ownership from an American-led consortium to a Russian-led one places the operational and logistical baseline of the Sea Launch system in jeopardy, especially when viewed in terms of it becoming a realistic alternative for the DoD to use in accessing space.¹¹²

D. CONCLUSION

Several proponents within the DoD, NATO, and the space launch industry argue that a partnership in the space launch realm would offer more benefits to the DoD than just launching a satellite more efficiently. Most notably, Air Commodore Jan A. H. van Hoof asserts that to achieve NATO's key space operations concerns there should be a greater amount of cooperation to assure access to the space domain

¹⁰⁹ Stephen Clark, "Sea Launch post bankruptcy plan wins court approval," *Spaceflight Now*, July 27, 2010.

¹¹⁰ Clark, "Sea Launch post bankruptcy plan wins court approval."

¹¹¹ Ibid.

¹¹² Joosung Lee, "Legal analysis of Sea Launch License: National Security and environmental concerns," *Space Policy* 24, (2008): 108-111.

for all its members.¹¹³ This position is echoed within the DoD, citing that they would benefit from such an international partnership by creating a technological interdependence between the United States and its key European allies if they were to extend the level of interoperability and cooperation between key allied nations.¹¹⁴ This would help to reduce stringent and outdated export restrictions, which would potentially result in a greater level of cooperation between the EU and the United States on space-related matters.¹¹⁵

The matter of launching American-made satellites with foreign systems is not a new concept. The space launch industry has become extremely competitive, driven by the large number of space launch providers who are capable of reliably and efficiently launching satellites into orbit. Numerous U.S.-produced satellite systems, intended for both commercial and civil missions, have already been launched from foreign launch systems. This factor within the current space launch environment is important for the DoD to understand as it moves forwards in meeting its access to space mission for several important reasons.

First, it shows that American-based corporations can successfully launch and their satellites systems from foreign suppliers, eliminating the bureaucratic and technical risks present in the infrastructures and operating

¹¹³ Jan A.H. Van Hoof, "Coalition Space Operations: A NATO Perspective," *High Frontier* 6, no. 2 (2010): 7-9.

¹¹⁴ Peter Hays and Dennis Danielson, "Improving Space Security through Enhanced International Cooperation," *High Frontier* 6, no. 2 (February 2010), 13-18.

¹¹⁵ Jaramillo, *Space Security 2010*, 14.

protocols between them. Second, it illustrates that when the capability and reliability of domestic and foreign systems are equal, the cost of delivering a system to space can trump concerns of using a foreign corporation to meet access to space needs. Third, since NASA has successfully contracted with and used foreign space launch suppliers to meet its mission needs, there is now a legal and political precedence for the U.S. government and the DoD to launch other government systems using a collaborative approach between domestic and foreign service providers. Finally, and perhaps most applicable, it indicates that the risk of transferring a potential dual-use technology, inherent in U.S. satellite systems, to foreign nations is minimal with the proper protocols in place. This logic holds, since the same manufacturers who produce satellites for the commercial and civil customers are in many instances using the same technology to build and field DoD systems. These factors encourage the belief that the government should not dismiss the option to use foreign suppliers if they can do so in a safe, secure, and cost-effective manner.

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IV. CONTRIBUTING FACTORS

Should the United States pursue a strategy to fulfill their assured access to space requirements based solely on the capability, reliability, and relative cost of a space launch system? That choice may not be the driving factor behind the decision to mandate the DoD to exclusively use domestic suppliers. Instead, the decision may be linked to political and economic factors that are influencing, if not forcing, the DoD to operate in the manner in which it is to procure and maintain its access to space requirements.

This chapter presents an overview of other contributing factors that may potentially be influencing the DoD's consistent and unyielding strategy. First, this chapter explores the influence that the current export control laws and regulations have on the DoD. While these laws are designed primarily to regulate and control the commercial entities within the United States, the two sides of the coin cannot be separated. History has shown that commercial and government programs are interdependent, and if a restriction is placed on one entity, it will inevitably affect the other. The next section explores the notion that the DoD is pursuing their current methodology as part of a greater strategy designed to protect and bolster the American space industrial base. This form of "economic protectionism," while intended to protect and stimulate the economic base, may in fact be creating more unfavorable consequences than intended. The final section evaluates the interpretation of the 2010 National Security Strategy to determine what, if

any, national security implications may come with the DoD's use of a foreign versus domestic space launch provider.

A. EXPORT CONTROL LAWS AND REGULATIONS

The 2010 National Space Policy is constructed not only to satisfy the President's National Security Strategy, but also to fall in line with current policies and laws governing the protection of sensitive space-related technologies. It is through this elaborate set of regulations that the DoD's ability to efficiently and reliably meet its access to space requirements is becoming an issue. These policies and regulations are limiting the number of viable options available for use by the DoD, civil, and commercial satellite manufacturers to choose from when deciding how to best launch their satellites. This point is further exacerbated by the Department of States' interpretation and implementation of its International Traffic in Arms Regulations (ITAR) as it pertains to satellite and launch vehicle exports.

The Arms Control Act of 1998 (22 U.S.C. 2778) established the International Traffic in Arms Regulation as the governing body of regulation that formed the building blocks which was later incorporated into the Code of Federal Regulations (22 CFR 120-130) concerning the use of foreign space launch systems. The importance of this regulation is that it grants the President the authority to "...control the export and import of defense articles and defense services."¹¹⁶ Furthermore, it delegates this authority to

¹¹⁶ Code of Federal Regulations, "General Authorities and Eligibility," Legal Citation: 22 CFR 120.1 (2010), 460.

the U.S. Department of State, not only to decide which defense articles and services are subject to ITAR, but also to manage the ITAR program as a whole. The regulation goes on to clarify that communication, remote sensing, scientific research, navigation, experimental, and multi-mission satellites are to be considered "Significant Military Equipment" because of their "capacity for substantial military utility or capability."¹¹⁷ Therefore, all DoD satellites fall under the ITAR's purview, regardless of their classification or technological sensitivity level.

Recently, numerous agencies and government reviews have noted that this restrictive regulation is in fact doing more harm than good to preserve America's national security when viewed in the context of assured access to space.¹¹⁸ A report issued from the Center for Space and Defense Studies examined the bureaucratic politics behind the implementation and enforcement of domestic satellite export controls.¹¹⁹ The report examined not only the effects of export controls upon the DoD, but went on to show how overly stringent export controls on commercial satellites affect economic and national security. The legal basis behind restricting

¹¹⁷ Code of Federal Regulations, "Significant Military Equipment," Legal citation: 22 *CFR* 120.7 (2010), 463; Code of Federal Regulations, "General: The United States Munitions List," Legal citation: 22 *CFR* 121.1 (2010), 483.

¹¹⁸ Eligar Sadeh, "Bureaucratic Politics and Satellite Export Controls," *Astropolitics: The International Journal of Space Politics & Policy* 5, no. 3 (2007), 289-302; David Berteau et al., *National Security and the Commercial Space Sector* (Washington D.C.: Center for Strategic and International Studies, 2010), 4-30; Peter Hays and Dennis Danielson, "Improving Space Security through Enhanced International Cooperation," *High Frontier* 6, no. 2 (February 2010), 13-18; Elizabeth Waldrop, "Integration of Military and Civilian Space Assets: Legal and National Security Implications" (Thesis, McGill University Montreal, 2003), 10-26.

¹¹⁹ Sadeh, "Bureaucratic Politics and Satellite Export Controls."

commercial satellites launched from foreign systems is a side effect of trying to contain the spread of American technology deemed dual-use to our international rivals; as such, the Executive branch handles the export of such technology in the same manner as it would handle the trafficking control of weapon technology.¹²⁰ The report concluded that after the 9/11 terrorist attacks against the United States, business and economic concerns would never again trump national security concerns.¹²¹ Therefore, an overly stringent export control policy has endured, weakening the American defense industrial base upon which the DoD has become reliant for its access to space requirements.

These findings are not solitary. The Center for Strategic and International Studies (CSIS) conducted a study to examine the relationship between the current export control strategy and its effects on national security.¹²² While the findings of the report do acknowledge that the current export controls on space-related technology are overly stringent, the report went on to examine the economic and national security implications of maintaining such an archaic system. The CSIS report, however, goes on to show why mandating U.S. commercial and defense satellites to be launched exclusively from domestic launch systems is creating an environment that is eroding the U.S. space-industrial base, and that America's assured access to space

¹²⁰ Sadeh, "Bureaucratic Politics and Satellite Export Controls," 289.

¹²¹ Sadeh, "Bureaucratic Politics and Satellite Export Controls," 302.

¹²² Berteau, *National Security and the Commercial Space Sector*.

should be viewed and treated as an important national security priority, rather than a by-product of it.¹²³

One of the most significant actions taken to address this issue was the passage of the Commercial Space Launch Act (CSLA) in 1988, and its amended version in 2004. The CSLA was intended to increase the level of commercial involvement in the space launch industry, which in turn could spur economic growth in this area, thus fulfilling not only America's national security concerns, but addressing its economic concerns as well.¹²⁴ At the time, the optimal method of satisfying this national security priority was to develop additional capacity through commercial means and then maintain a robust and reliable space launch program with enough capacity to launch all commercial and DoD satellites.¹²⁵

Unfortunately, the current export control regulations and national space policies have created an environment that primarily protects America's national security assets, rather than preserving the defense industrial base. Since 1995, the United States has gone from being the preeminent space power, controlling 73 percent of the market, to controlling only 25 percent, just a decade later.¹²⁶

¹²³ Berteau, *National Security and the Commercial Space Sector*, 1-3.

¹²⁴ Bonnie E. Fought, "Legal Aspects of the Commercialization of Space Transportation Systems" (J.D. diss., University of California, Berkeley, 1989).

¹²⁵ Berteau, *National Security and the Commercial Space Sector*, 17-19.

¹²⁶ Berteau, *National Security and the Commercial Space Sector*, 23.

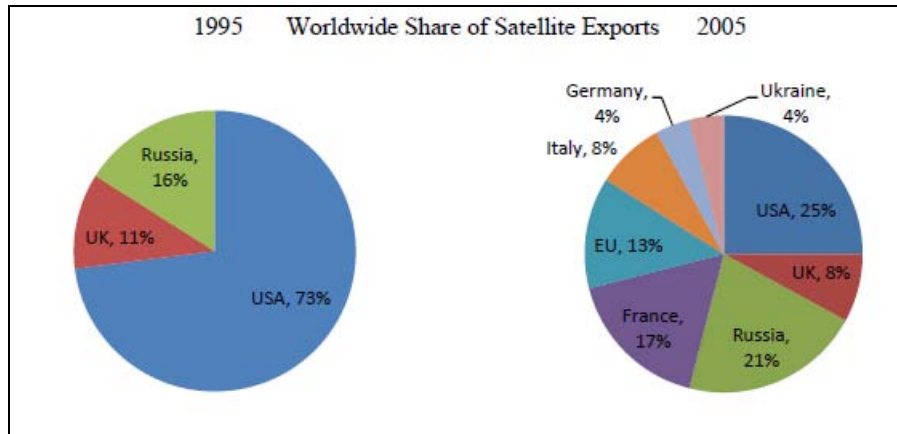


Figure 9. Waning Dominance of United States in Space¹²⁷

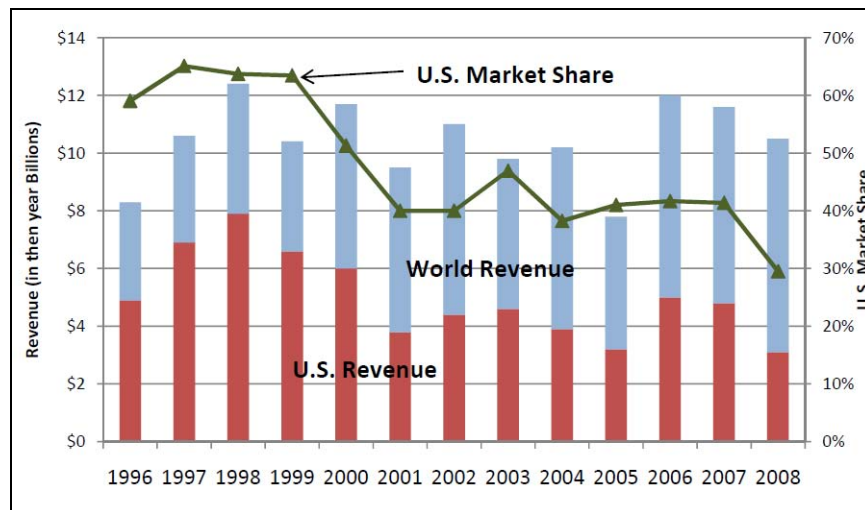


Figure 10. U.S. Market Share of Commercial and Government Satellites¹²⁸

This paradigm shift has resulted in an industrial base that is continuing to lose its competitive edge in the global market and is becoming more dependent on government subsidization to remain competitive and viable. While it

¹²⁷ Berteau, *National Security and the Commercial Space Sector*, 23; National Air and Space Intelligence Center, 2006.

¹²⁸ Berteau, *National Security and the Commercial Space Sector*, 23; Satellite Industry Association, *State of the Satellite Industry Reports*, 2005-2009.

cannot said that this trend is a causal effect of the current export control regulations, numerous proponents tend to agree that these regulations certainly are not helping to address the issue or to aid in reversing the trend.¹²⁹

Since the U.S.-produced satellites came under the Department of State's ITAR purview in 1998, the DoD's ability to launch satellites from a foreign launch system has been expressly prohibited unless the President testifies before Congress that it is a matter of national security.¹³⁰ While these measures were primarily designed to protect the sensitive nature of systems developed for national security reasons, many believe that the regulatory system, which was developed during the Cold War, needs to be revamped to reflect the realities of the twenty-first century.

The debate, as to whether the existing export control system needs to be overhauled, is ongoing. In August of 2009, President Obama commissioned a review to examine the merits of the current export control regime, in particular, the complicated and overly restrictive nature of ITAR.¹³¹ The Secretary of Defense, Robert Gates, went on record to state that as it pertains to ITAR, "stringent is not the same as effective," citing that the United States has one of the most stringent export control systems in the world. Rather than protecting the United States and its interests,

¹²⁹ Jeffrey Hill, "Intelsat's Spector: CSIS Findings Crucial to Fix U.S. Commercial Launch Options," *Satellite News* 33, no. 31, August 4, 2010, , 1-3; Berteau, *National Security and the Commercial Space Sector*, 12-15; Waldrop, "Integration of Military and Civilian Space Assets: Legal and National Security Implications," 17-20.

¹³⁰ Code of Federal Regulations, "General Authorities and Eligibility," Legal Citation: 22 *CFR* 120.1 (2010), 460.

¹³¹ Ken Pole, "ITAR Update: Where Stringency and Efficacy Part Company," *Frontline Defense*, Issue 3 (2010), 26.

however, it is creating an environment that is difficult to enforce, and is eroding the commercial opportunities of the defense industrial base.¹³² The national security reasons as to why the current export control system needs to be overhauled was nicely summarized by Secretary Gates when he stated, "The current export-control regime impedes the effectiveness of our closet military allies, tests their patience and goodwill, and hinders their ability to coordinate with U.S. forces."¹³³

B. ECONOMIC PROTECTIONISM THROUGH GOVERNMENT SUBSIDIES

While the DoD's procurement strategy is touted as being guided by policy and legislation aimed at bolstering America's national security interests, one cannot help but question whether the measures taken are based on economic or security reasons. As already established, the CSLA established the legal framework for how the American space launch industry interacted with both the DoD and commercial customers to promote the American industrial base. Consequently, the 1989 U.S. National Space Policy focused on growing the commercial industry based on free and open market principles. In fact, the 1989 U.S. National Space Policy explicitly stated, "The United States will, as a matter of policy, pursue its commercial space objectives without the use of direct Federal subsidies."¹³⁴ The key point to recognize is twofold. First, the 1989 U.S.

¹³² Pole, "ITAR Update: Where Stringency and Efficacy Part Company," 26-27; Robert Gates, "Remarks by the Secretary of Defense on Export-Control Reform."

¹³³ Gates, "Remarks by the Secretary of Defense on Export-Control."

¹³⁴ George H.W. Bush, "National Space Policy," *NASA Historical Reference Collection* (1989).

National Space Policy alludes to withholding only "direct" subsidies and, second, that this language disappeared from any and all subsequent U.S. Space Policy documents issued since 1989.

Since the early 1990s, the United States has appeared to skirt its policy of not providing direct subsidies to the space launch industry and, instead, providing indirect subsidies through military support and exclusive procurement contracts.¹³⁵ Through indirect subsidies, the DoD is transferring knowledge, technology, research, development capital, and critical infrastructure items by means of DoD-funded procurement activities. In fact, every country involved in space launch during this period received some form of government subsidies, which only further blurred the boundaries of the proper use of government subsidies.¹³⁶

If the government were not involved in providing key resources and capital to the space launch industry, much of the competitive advantages American corporations have in the international marketplace may not exist. Several critics assert that the government actively pursues the practice of subsidizing the defense industrial base using DoD contracts, in an effort to ensure American maintains its superiority in the sector.¹³⁷ Yet the executive branch continually underscores the significance of needing to support the industry for both national security and economic reasons.¹³⁸

¹³⁵ Lai, "National Subsidies in the International Commercial Launch Market," 21.

¹³⁶ Lai, "National Subsidies in the International Commercial Launch Market," 31-32.

¹³⁷ Lawrence, *Aerospace Strategic Trade*, 158.

¹³⁸ Lawrence, *Aerospace Strategic Trade*, 114.

Throughout the economic and fiscal policy realm, there is a general understanding of how and when governments should subsidize an industry. Commonly accepted economic theory states that government subsidies generally should fall into one of four categories: offsetting various market imperfections, exploiting economies of scale in production, meeting social policy objectives (including the protection of the defense industrial base), and changing the distribution of income and increasing or retaining employment.¹³⁹ From this perspective, subsidies should be used either to redistribute equity to the populace, or to help correct some shortcomings in achieving a comparative advantage in the global marketplace.¹⁴⁰ One of the reasons leading to the creation of the World Trade Organization (WTO) was an effort to regulate international trade, and it has endeavored to define a subsidy as "a financial contribution, by a government or public body within the state, and which confers a benefit."¹⁴¹ However, governments frequently provide subsidies indirectly through military and civilian procurement contracts that go against the notion of a free market society. Notwithstanding, this form of aid is seen throughout highly technical industries that are considered a national interest by their respective governments. These governments, therefore, employ fiscal policy to create advantages in the market place through

¹³⁹ *Routledge Encyclopedia of International Political Economy*, Volume 3, ed. R.J. Barry Jones (Ney York: Routledge, 2001), s.v. "Subsidies," 1516.

¹⁴⁰ Albert Breton, *Competitive Governments: An Economic Theory of Politics and Public Finance* (Cambridge, MA: Cambridge University Press, 1996), 30-34.

¹⁴¹ K. Hayward, "Trade Disputes in the Commercial Aircraft Industry: A Background Note," *The Aeronautical Journal* 109, no. 1094 (2005), 159.

conscious government actions, in effect creating a competitive advantage rather than relying on the free market system to gain a comparative advantage.¹⁴² It could, therefore, be inferred that the use of government contracts to provide industries with money might also be viewed as another recognized subsidy source.

Additionally, it is evident that most industrialized nations not only provide direct, but indirect subsidies to companies and industries through military and civil institutions by means such as research and development (R&D) initiatives, as well as procurement contracts.¹⁴³ This effort is considered acceptable because it is viewed as a social good through which the entire nation benefits. The overt government investment through R&D subsidies has proven to generate high rates of return and produce an overall long-term benefit to the nation, thereby expanding the role the government has played to promote innovation over the past three decades.¹⁴⁴ Unfortunately, this form of aid could be viewed as distorting the true nature of why subsidies are provided in the first place, blurring the role governments should play in where and when to intervene in the marketplace—not to mention how the use of government subsidies affect the profitability of corporations who win these government contracts.

¹⁴² Lawrence, *Aerospace Strategic Trade*, 13-14.

¹⁴³ Breton, *Competitive Governments*, 252.

¹⁴⁴ Fred Block, "Where Do Innovations Come From? Transformations in the US Economy, 1970-2006," *Socio-Economic Review* 7, no. 3 (2009), 475; Razin, Assaf, and Efraim Sadka, *The Economics of Globalization: Policy Perspectives from Public Economics* (Cambridge, UK: Cambridge University Press, 1999), 18.

While it is clear that there are numerous advantages to the U.S. government subsidizing the space launch industry, it can also be viewed as a crutch. If the industry has indeed become reliant on the government to provide it with the necessary funding to conduct R&D and its basic operational expenses, then the government is weakening the domestic industry's ability to compete in the global market, let alone to stay in business. If the space launch industry is becoming overly reliant on the U.S. government, then the very policies and practices we are employing to bolster our national security and access to space is actually having the opposite effect.

The controversy over the national security implication of promoting and fostering an industry out of protectionist ambitions is not new. For years, economists and strategists have studied this very issue in an effort to determine the proper mix of domestic versus foreign reliance in critical areas of defense.¹⁴⁵ Should the DoD and federal government develop and foster an industry that it supports with the state's resources and controls with legal regulations, and then require that domestic and public entities use the service exclusively? A review conducted by Theodore Moran analyzed the competition that took place during the North Atlantic Treaty Organization's (NATO) competition for a new airborne warning system between Boeing's Airborne Warning and Control System (AWACS) and the British Nimrod Airborne Early Warning system in the late 1970s. The results illustrate the risk of relying on a "purely state system"

¹⁴⁵ Theodore H. Moran, "The Globalization of America's Defense Industries: Managing the Threat of Foreign Dependence," *International Security* 15, no. 1 (summer 1990), 57-59.

verses developing a system that was born from an international consortium.¹⁴⁶ The Nimrod was considered by many to be a superior system compared to the Boeing AWACS, but lost the contract because of its inability to incorporate multinational requirements and assistance necessary to adapt to a dynamically changing environment, thereby creating a situation that resulted in numerous delays and uncontrollable cost escalations.¹⁴⁷ This situation, while not exactly the same as what is transpiring with the American space launch industry, does have many similarities. It indicates how protectionist policies intended to create a "nationalized" product for national security reasons can, in the end fail, if it is unable to adapt to the changing environment.

A review of the use of government subsidies in the space launch market thus concluded that the use of the DoD as a tool to achieve economic goals would ultimately be a mistake, which would encourage the commercial defense industrial base to focus more on winning DoD contracts, while neglecting its commercial focus.¹⁴⁸ Unfortunately, the idea that this could happen in the space launch industry is not foreign. In fact, in the early days of the Titan launch system, Martin Marietta opted out of the commercial

¹⁴⁶ Arnold Lee Tessmer, *Politics of compromise: NATO and AWACS* (Washington, D.C.: National Defense University Press, 1988), 32-56; Moran, "The Globalization of America's Defense Industries: Managing the Threat of Foreign Dependence," 67-68

¹⁴⁷ Moran, "The Globalization of America's Defense Industries," 67-68.

¹⁴⁸ Lai, "National Subsidies in the International Commercial Launch Market," 31.

launch market to pursue DoD contracts exclusively, a trend that appears to be reemerging with the EELV program.¹⁴⁹

C. NATIONAL SECURITY CONCERNS

In May of 2010, the Obama administration released an updated version of America's National Security Strategy (NSS). The 2010 NSS is a departure from the 2002 NSS, outlining a more strategic approach to achieving national security, which is supported heavily with calls for international cooperation to bolster America's security, prosperity, values, and international stability.¹⁵⁰ The NSS recognizes that the value of maintaining America's access to space is not only that it will enhance our national security, but also that it is a key component of America's prosperity, as well as acting as a "catalyst for innovation."¹⁵¹ This fact has led many experts to argue that maintaining America's access to space is critical to preserving its role as a leader in global commerce, scientific advancement, and military dominance.¹⁵² Therefore, to achieve the goals set forth in the NSS, the government and industry need to find a balancing point between a state-run program and one that continues to operate within the free market society and is not dependant on DoD subsidies.

¹⁴⁹ Lai, "National Subsidies in the International Commercial Launch Market," 31.

¹⁵⁰ Executive Office of the President, *National Security Strategy* (Washington D.C.: The White House, May 2010), 1-7.

¹⁵¹ Executive Office of the President, *National Security Strategy*, 18, 31.

¹⁵² Executive Office of the President, *National Security Strategy*, 18, 31.

The belief that America must assure its continued unfettered access to space is not in question. What is in question is why current policies mandate that the DoD must maintain a domestic launch capability and that it cannot use foreign suppliers to meet the department's requirements. The NSS and the U.S. National Space Policy make note that it is in the interest of "national security" that the DoD must preserve and maintain this capability. However, the approach to nationalize the American space launch industry appears to be producing numerous unintended consequences, the least of which is the declining dominance of American satellite and space launch systems in the global market. Many proponents with the industry believe that the restrictive rules and regulations placed on the industry by the federal government is a leading cause of the industry's decline in the global marketplace.¹⁵³

A report recently issued by the Center for Strategic and Internal Studies examined the "militarization" of the domestic space launch industry by the DoD and its effects on America's national security.¹⁵⁴ The report reinforced that America's access to, and the use of, space was critical for our national security and that the DoD's role in maintaining it had become a critical factor that linked commercial, civil, and intelligence agencies together.

¹⁵³ Hill, "Intelsat's Spector: CSIS Findings Crucial to Fix U.S. Commercial Launch Options," 1-3; Lai, "National Subsidies in the International Commercial Launch Market," 32-33; Sadeh, "Bureaucratic Politics and Satellite Export Controls," 302.

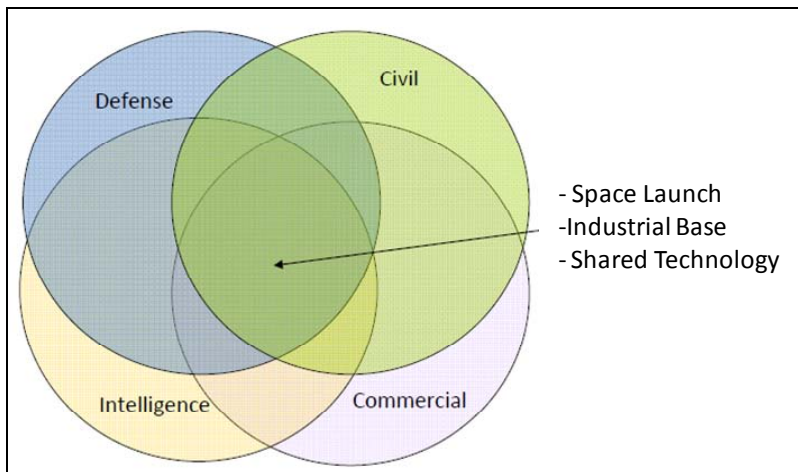


Figure 11. Interconnectedness of Space Launch¹⁵⁵

The report went on to recognize that the DoD's assured access to space requirement is currently being fulfilled by ULA and that the DoD was quickly becoming its dominant customer.¹⁵⁶ As such, the DoD also dominated the space launch manifest, thereby creating a lack of availability to launch anything other than DoD satellites, which in and of itself is depressing the domestic launch market even further.¹⁵⁷ This disparity is further exacerbated by the fact that, similar to the DoD, domestically produced satellites cannot be launched from foreign systems without express approval from the Department of State and Department of Commerce as part of the ITAR process to protect potential dual technologies. These policies and practices have

¹⁵⁴ Berteau, *National Security and the Commercial Space Sector*, 12-21.

¹⁵⁵ Berteau, *National Security and the Commercial Space Sector*, 6.

¹⁵⁶ Berteau, *National Security and the Commercial Space Sector*, 14.

¹⁵⁷ Berteau, *National Security and the Commercial Space Sector*, 14-16.

resulted in a depressed commercial market, which is forcing the DoD to subsidize the domestic space launch market more than ever to make up for lost commercial business.

Based on the facts concerning the state of the domestic launch market, the national security concerns centering around the DoD's use of domestic space launch providers is somewhat at odds with itself. The 2010 NSS seeks to promote national security through bolstering American's security while invigorating the economy. In regards to space and space-related matters, it appears that the NSS is promulgating a strategy that may be bolstering the DoD's ability to maintain its access to space for national security means; unfortunately, it is also suffocating the very industry that is providing the DoD with the capability to do so. In the end, this may ultimately affect the DoD's ability to maintain its current access to space methodology.

D. CONCLUSION

To determine whether the DoD is effectively achieving the government's mandate, as set forth in the 2010 National Space Policy to "provide reliable, affordable, and timely space access," this chapter presented several issues prevalent in the current space launch environment.¹⁵⁸ The primary issue centered on the examination of three contributing factors: ineffective export control regulations, the use of protectionist policies and government subsidies, and a National Security Strategy that creates conflict between maintaining security and economic

¹⁵⁸ Executive Office of the President, National Science and Technology Council, *U.S. National Space Policy*, 14.

prosperity. While not directly influencing the DoD's ability to access space, these three factors do affect the manner in which the DoD must go about achieving it, which subsequently affects the defense industrial base's ability to deliver and maintain this capability for the nation as a whole.

When examining the DoD's ability to continue its current strategy to access space, one simply cannot look at the policies and practices employed by the DoD. In effect, several policies and regulations designed to protect America's national security, are having several unintended consequences. Regulations such as the outdated export controls and ITAR, originally intended to protect sensitive American technology, have turned into an ineffectual set of policies; rather than protecting the American defense industrial base, they have begun to stifle its ability to compete and survive without the assistance of the DoD. Forcing many high-ranking officials in the government to call for a review of these outdated regulations and replace it with a system that is more in line with today's requirements.

The primary reason the current policies and regulations surrounding America's space launch industry need to be revamped is that the DoD cannot continue to subsidize the space launch industry as it has over the past decade. The nation has seen an industry that began as a public venture turned commercial and has begun slowly returning to a DoD financed industry. The methodology of using indirect subsidies to maintain the industry has many critics in the field arguing that this form of "economic protectionism" is, in effect, weakening America's capability rather than

enhancing it. In addition, the space launch industry's dependency on subsidies is developing an industry that is more focused on meeting the needs of the DoD rather than being able to effectively compete within the domestic and international markets, thus creating a cycle of dependency and disequilibrium within the market. More importantly, the focus on meeting the requirements of the DoD has resulted in an inability of commercial customers to launch their satellites when they need to. This policy creates schedule delays that result in lost revenue for American satellite manufacturers, prompting many of them to seek permission to launch abroad rather than domestically. This cycle culminates in the DoD paying a higher allocation of the associated costs required to preserve the space launch infrastructure.

In summary, these regulatory and fiscal policy measures, which were originally designed to protect America's national security, appear to be having the opposite effect. The current export control laws have devolved into a series of protectionist policies designed to enhance the DoD's ability to access to space while simultaneously stimulating the economy. Unfortunately, the policies seem to be at odds with each other, creating a paradox between maintaining our military capability and preserving America's economic stability. This situation has manifested from a commercially driven free market concept into a government-supported infrastructure, which has forced the DoD to subsidize a greater of the space launch infrastructure. The question remains: If the DoD cannot continue to subsidize the increasing cost of the domestic

space launch infrastructure, who will pick up the bill, and can it survive within the new global space launch market without the DoD?

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The research presented in this thesis addresses the affectivity and efficiency of the DoDs current space launch strategy as a means to guarantee the department's access to space. The policies established by the U.S. government were designed to enhance our national security through preserving the DoD's ability to access space, while ensuring that the United States maintains the domestic capability to do so independently. This involves establishing and mandating a series of regulations and policies that the DoD and the defense industrial base must follow, irrespective of the long-term impact.

This situation, coupled with a weak demand for space launch services, has created an American space launch industry that is almost completely dependent on the United States government to support it through indirect subsidies from the DoD. Unfortunately, the solution the DoD and the commercial industry created is plagued with personnel and programmatic issues. Over the past decade, these issues have manifested into a series of uncontrolled cost escalations and the inability of the DoD or ULA to provide accurate cost forecasts for what it will take to continue and fund the program into the future.

The situation is further complicated by the fact that the DoD is required by law to use and maintain American-based firms to meet its space launch requirements. Unfortunately, the cost for the DoD to follow this guidance

is becoming increasingly more expensive, outpacing the DoD's target growth rate of 3 percent by more than a factor of four. However, there are numerous international consortiums that offer space launch services to commercial and government customers at a fraction of what the DoD is currently paying to maintain ULA's capability. Unfortunately, the DoD is prohibited from exploring these alternatives out of what appears to be a series of protectionist regulations aimed at preserving the defense industrial base, rather than enabling the DoD to achieve its goal of providing reliable and efficient access to space in the most fiscally responsible manner. The question that remains unanswered is: How long can the U.S. government and the DoD continue to employ a strategy that does not seek to optimize its efforts to assure the DoD's access to space? It appears that the DoD and government policy makers have created a situation in which they have no choice but to continue to subsidize the domestic space launch industry, due to the likelihood that, if they do not, the industry may fail altogether.

B. RECOMMENDATIONS

1. Domestic and Foreign Space Launch Providers as Partners, Not Competitors

Since the turn of the century, the United States and the DoD have come to realize the importance of international collaboration to achieve our nation's goals. The acceptance of this new reality is prevalent in nearly every facet of the 2010 U.S. National Space Policy except one: assuring access to space for the Department of Defense. The 2010

policy takes bold steps to outline how important international collaboration is to achieve the goals set forth in the policy, yet it is explicit in stating that the only way to enhance the United States' assured access to space capabilities is to continue to pursue it independently, rather than incorporate international cooperation.

The realities of the twenty-first century and the lessons learned over the past decade must be applied to how our nation fights wars, as well as how the DoD delivers the tools and capabilities to effectively do so. The DoD needs to optimize how it goes about defending our nation in the most efficient manner possible. One such solution is to form partnerships with America's economic and military allies to create a more robust and resilient space launch capability. The use of multiple providers to achieve the DoD's access to space can effectively broaden the DoD's capability, flexibility, and interoperability, while eliminating a potential single-source failure and reduce the overall cost. The amount of international collaboration the DoD enters into is dependent on balancing the national security requirement to maintain a domestic capability with fostering and strengthening international ties with key allies. As technology advances and the associated cost burdens continue to increase, the DoD cannot afford to continue to isolate itself from its allies and international partners. The time is right to begin embracing a new strategy of international cooperation to assure the DoD access to space.

2. The Need for a Transformational Mindset and the Realities of the Domestic Space Launch Industry

When the Commercial Space Launch Act was signed into law in 1988, the government tried to expand its capability to access space, from what was a purely government function to a commercially driven industry. Now, in an era when the defense industrial base can no longer maintain this capability without significant government subsidies, the DoD is faced with the fact that certain steps must be taken to preserve this capability. The question is: Should the United States continue to invest billions of dollars into the domestic space launch market, or should it seek to embrace a new mindset through the adoption of a new assured access to space strategy? The reality is that the current solution employed by the DoD, while technologically achievable, has been plagued by unstable cost increases since the program's inception. These costs have increased at a rate of nearly 16.2 percent per year for the past decade, making it the fastest-growing procurement activity within the DoD.

The current strategy to maintain the DoD's access to space is built on the premise that it is in the nation's best interest to preserve our current space launch capability for national security reasons. However, the regulations and policies set forth to codify this position appear to be based more on preserving our capability from an economic rather than a national security standpoint. In August of 2009, the President directed that many of the regulations and policies governing export control and the governance of dual-use technology be reviewed to determine

if they warrant being modified to reflect the current national security environment. The time is ripe to modernize the regulations and policies that govern America's assured access to space. Many of the ineffective and outdated export control regulations and guidelines are restricting the DoD from implementing a strategy that is potentially not only more effective, but efficient as well.

The commercialization of the national space launch industry in 1988 was driven by the need to create redundancy within the industry and eliminate the monopoly held by the government. Unfortunately, the policy makers failed to learn from the lessons of the past. The development of the EELV program and the 2005 merger of The Boeing Company and Lockheed Martin Corporation into one joint venture have returned the DoD to a state of relying on a single provider to meet its access to space requirements once again. Unless the government takes steps to diversify and expand the options available for use by the DoD, the nation is one accident away from potentially losing its ability to access space when required. If history has taught us anything, it is that the DoD cannot afford to lose its ability to access space as it did after the Space Shuttle Challenger exploded in 1986, which was a tragic event that resulted in the inability of the DoD to launch any military satellites for almost three years.

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